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AIR EXHAUSTER WITH DAMPER MEANS

Filed Aug. 11, 1966

2 Sheets-Sheet 1

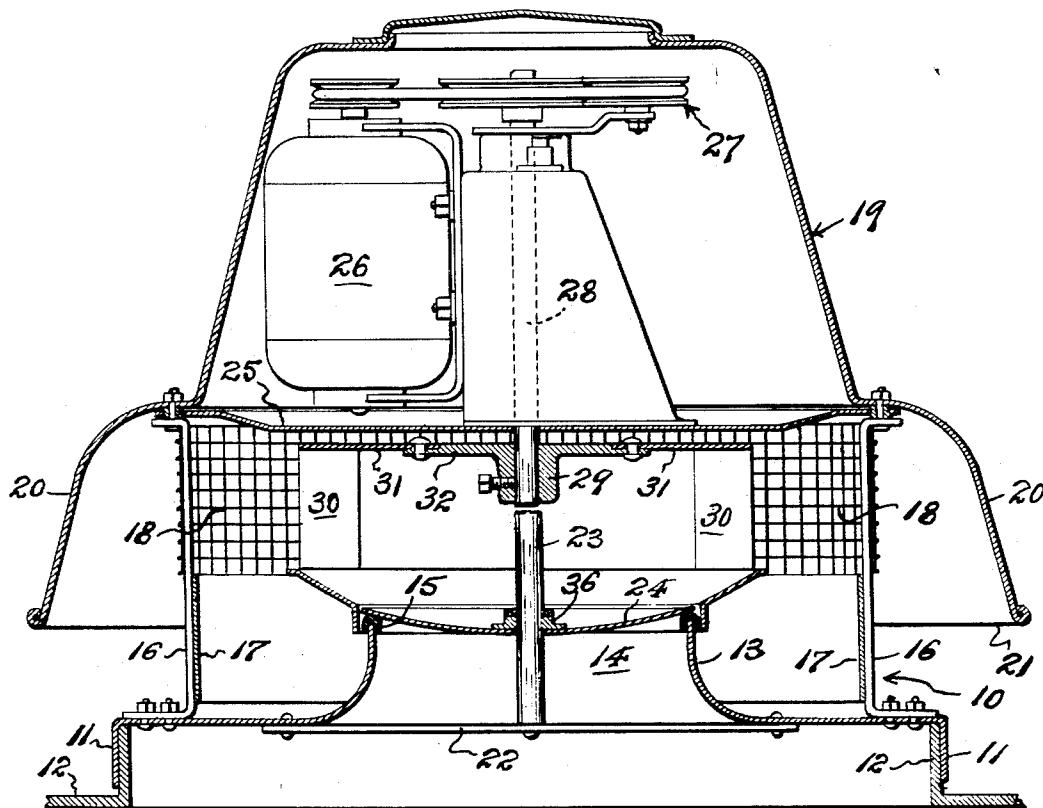


Fig. 1

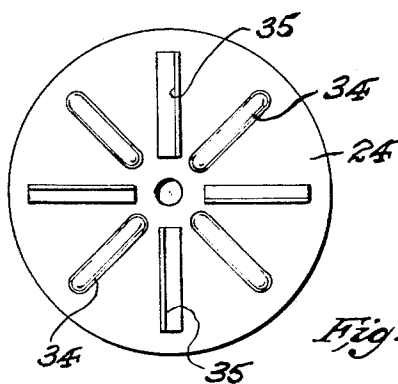


Fig. 3

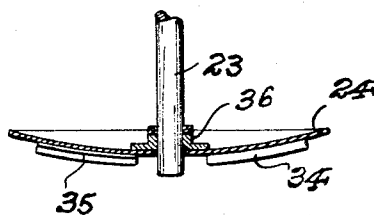


Fig. 4

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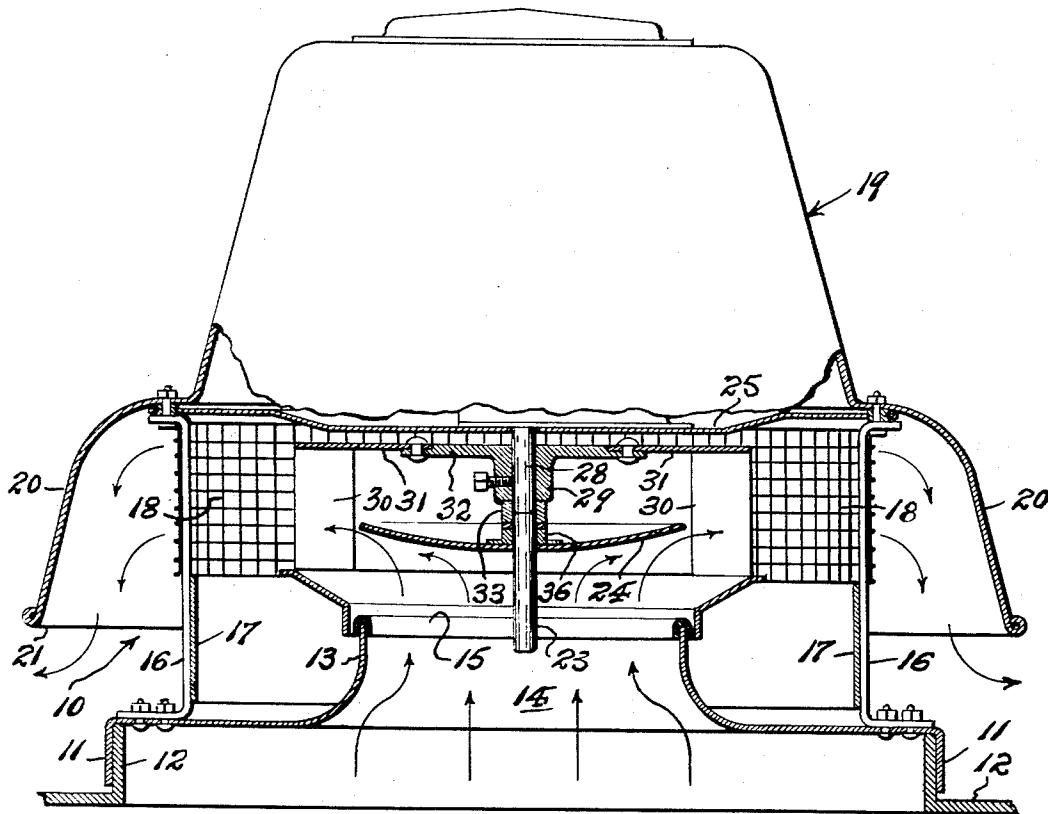
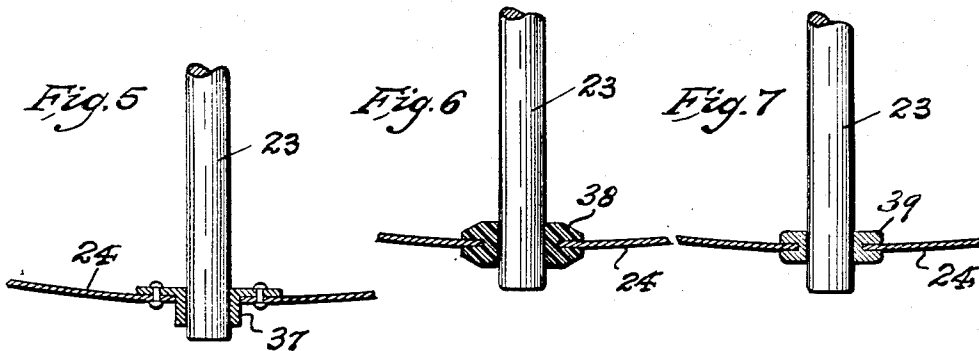


Fig. 2



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AIR EXHAUSTER WITH DAMPER MEANS
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ABSTRACT OF THE DISCLOSURE

An air exhauster for exhausting air from an enclosed space which include a conduit, a concave damper member slidably mounted on a shaft for movement between an open position and a position in which the damper rests on and closes the conduit, and motor driven air impeller means. When the air impeller means is operated, the damper rides up the shaft on the current of air flowing out of the enclosure and falls back by gravity to closed position when the impeller is stopped. The damper may be mounted on a fixed shaft, in which case it is provided with vanes upon which flowing air acts to cause the damper to rotate on the shaft. Alternatively, the shaft on which the damper is mounted may be motor driven to impart rotary motion to the damper due to friction between the damper and shaft. The rotary motion of the damper speeds up the opening of the damper but slows the closing to provide smooth operation.

The present invention relates to ventilating devices and dampers therefore and, more particularly, to improved exhaust devices having integral back draft dampers adapted to open and close an air passage automatically on starting and stopping an air impeller.

Motor driven air impeller exhaust devices have been known for many years and are in widespread use. Such devices are useful, among other purposes for mounting on the roof of a building to facilitate ventilation by exhausting stale air, smoke or noxious gases through an opening in the roof, and drawing fresh air into the building through a suitable inlet. Roof exhausters of this type are normally mounted above a raised curb extending upwardly from and surrounding an opening in the roof. A shield or cover is normally mounted above the exhaust device in order to prevent rain and snow from falling directly into the building. Inasmuch as the weather shield, in order to provide for passage of exhaust air, must be spaced above the surface of the roof or curb, rain or snow falling at an angle or driven by wind or undesirable cold or hot air, may still enter the building. In order to prevent this, it is customary to employ suitable baffles, or preferably, a damper which completely closes the opening in the roof when the exhaust device is not in operation. Such dampers may be built into the roof or curb, or may be included as part of the exhaust device. Where the damper is built into the roof or curb, it is generally necessary to provide separate means to open and close it. Such means may be operated manually or by suitable mechanical or power driven devices. Dampers built into the roof or curb are generally undesirable, not only because they require auxiliary operating means, but due to the added time and cost entailed in their installation, operation and maintenance. Moreover, it has been found that dampers built into the roof or curb, if made sufficiently tight-fitting to be effective in keeping weather and cold or hot air out when closed, are difficult to operate, particularly if it is attempted to do so by other than direct mechanical means. On the other hand, built-in dampers which are made to fit loosely enough for easy operation, tend to leak air and water.

Attempts have been made to incorporate automatically operated dampers directly in the exhaust devices, but for the most part such devices have been unduly complex and therefore, not only costly to manufacture, but subject to failure in operation resulting in increased maintenance costs. One attempt to provide a less complex automatically operated damper within an exhaust device is described in Miller U.S. Patent 3,012,495, issued Dec. 12, 1961. The Miller device, which is relatively simple, employs a damper which floats freely upon the current of air being exhausted from the building. When the exhaust fan is turned off the Miller damper falls by gravity into contact with an opening in the device communicating with the interior of the building on which it is mounted. Inasmuch as the free floating damper of the Miller device is only loosely confined by peripheral guides as it rises and falls during opening and closing, and the plane of orientation of the damper may tilt with respect to the vertical axis thereof, seating of the damper on closing is haphazard, with the result that the integrity of the exhaust device against leakage of air and water leaves much to be desired.

It is apparent, therefore, that a need has existed in the industry for an improved exhaust device having a self-contained and automatic damper of simple and inexpensive construction, requiring a minimum of maintenance, and providing smooth operation, positive seating on closure and improved integrity against entry of weather into the building.

This need has now been satisfied by the improved exhaust devices and back draft dampers of the present invention, which comprise a damper element slidably mounted on a vertically disposed shaft for automatic operation under the influence of air pressure on the damper element. More specifically, the new exhaust devices comprise means for mounting directly on a curb around an exhaust opening, an impeller and associated drive means for exhausting air from the building, suitable weather shield means covering the device as a whole but disposed above the curb to provide space between the curb and shield for passage of air, and a novel damping device and associated seat therefor, the damping device including a vertically disposed shaft on which the damper is slidably mounted to rise and fall under the influence of air exhausted by the apparatus or back drafts from outside the building.

The invention will now be described in greater detail in conjunction with the accompanying drawings in which like reference numerals indicate like parts.

FIG. 1 is a vertical axial sectional view showing a ventilator of the present invention with its novel damper in closed position;

FIG. 2 is a vertical axial sectional view, in part elevation, of another ventilator of the invention showing a modified damper device in open position;

FIG. 3 is a bottom plan view of a modified form of damper element having vanes and/or embossments to promote rotation of said damper on its mounting shaft;

FIG. 4 is a vertical sectional view of the modified damper of FIG. 3;

FIG. 5 is a modified form of bearing bushing to support the damper, formed from metal, which may be oil bearing bronze;

FIG. 6 is a view similar to FIG. 5 showing a plastic bearing bushing;

FIG. 7 is a view similar to FIG. 5 showing a bearing bushing in the form of a grommet of metal, plastic or other suitable material.

Referring to the drawings in greater detail, and to FIG. 1 in particular, a ventilating device 10 of the present invention, comprises a curb cap 11 fastened to an upstanding curb 12 surrounding an opening in the roof of a build-

ing or other structure. Although the curb cap 11 illustrated in the drawings is rectangular, it may take any suitable shape conforming to the configuration of the curb which, of course, may be rectangular, square, circular, oval or any other suitable shape. The upper surface of the curb cap 11, while generally planar around its outer edges, projects upwardly from the planar portion at its center to form an upstanding conduit portion 13 having an axial passage 14 open at the top and bottom. The upper edge of the axial passage 14, which is disposed in a horizontal plane, is capped with a resilient seating member 15, preferably adapted to be press-fitted thereon. Supporting means 16, mounted on the curb cap 11 by bolts or other suitable means, are spaced outwardly from the ventilating conduit or orifice 13 and extend upwardly to a substantially greater height than said conduit 13. A cylindrical baffle member 17 mounted on the support members 16, extends upwardly from the curb cap 11 and surrounds and partially encloses the conduit or orifice 13. A cylindrical screen member 18 is also mounted on the support members 16 above the baffle 17. The screen 18 is preferably of relatively large mesh size, in order to prevent entry of leaves, paper and similar foreign materials without, however, restricting free flow of air out of the conduit 13. Also supported by the means 16 is a weather dome 19 having a lower bell portion 20 surrounding the upper portion of the support means 16 and the screen 18 and having its lower edge 21 spaced above the curb cap 11. The dome 19 is secured to the upper portion of the support means by bolts or other suitable means.

A support plate 22 is mounted on the lower side of the planar portion of the curb cap 11 by any suitable means so as to span, but not materially close the axial passage 14 in the conduit or orifice 13. The plate 22 may be two, three or four-armed depending on the span dimension. Fixedly mounted on the support plate 22 is a vertically disposed, axial guide shaft 22 which extends upwardly out of and above the plane of the opening in the top of the conduit 13. The shaft 23 may be composed of plastic or other noncorrosive material. A damper element or plate 24 having a central guide bushing 36 with an axial bore hole is slidably mounted on the guide shaft 23. The damper plate 24 is preferably, but not necessarily, concavo-convex as shown in FIG. 1, for example, and is disposed with its concave side up and its convex side down so that the latter rests upon the resilient seat 15, thus closing the opening at the top of conduit 13 and passage 14 as well.

A motor support plate 25 is mounted on the upper portions of supporting means 16 so as to span but not close the dome 19. An electric motor 26, connected to a source of current by conventional means not shown, is connected to a suitable belt and pulley or sheave drive mechanism 27 by any suitable means. The belt and pulley means 27 is connected to a vertical drive shaft 28 mounted in axial alignment with the guide shafts 23.

Mounted on the drive shaft 28, below the motor support plate 25 is an arbor 29 fixedly attached to the shaft by means of a set screw or other suitable means. An open ended and partially open sided cylindrical centrifugal wheel 30 is mounted for rotation with the drive shaft by means of brackets 31 connected to arms 32 of the arbor 29. The lower edge of the wheel 30 is inclined inwardly and downwardly and terminates at its lower edge in a straight-sided vertical portion which closely surrounds the resilient seat 15 and the opening in the top of conduit 13. The impeller wheel 30 may be made up of vertical side vanes or may have any suitable construction adapted to move air centrifugally. The belt and pulley means 27 may be eliminated and the motor 26 inverted so that its drive shaft extends downwardly through support plate 25 for direct connection to wheel 30. In this event the damper 24 can be mounted either as shown in FIG. 1 or FIG. 2.

In operation, the motor 26 is turned on by means of a conventional switch, not shown, to cause rotation of the drive shaft 28, arbor 29 and centrifugal wheel 30. Rotation of the wheel 30 impells air outwardly through the surrounding screen 18 and out of the lower bell portion 20 of the weather dome 19, thus causing a reduction in the air pressure above the damper element 24. The imbalance in air pressure between the opposite sides of the damper element 24 produced in this way permits the damper element to rise under the influence of the greater air pressure exerted from below and to slide upward on the guide shaft 23. This breaks the seal between the lower surface of the damper element 24 and the resilient seat means 15 and permits air to be exhausted from the building through the conduit 13 under the suctioning influence of the centrifugal wheel 30. The damper element 24 will ride upwardly on the guide shaft 23 to a height determined by the volume of air exhausted from the building through conduit 13. The apparatus is preferably designed to exhaust at least sufficient air to force the damper element 24 to its fully opened position adjacent the lower end of the arbor 29 on the drive shaft 28, thus permitting full flow of air between the seat member 15 and damper plate 24 and out through the sides of the impeller wheel 30. The upper portion of the dome 19 prevents entry of weather into the building from above, while the lower bell 20 of the dome, inhibits entry of weather laterally while the motor is running and the damper element 24 is in open position. When it is desired to discontinue exhausting air from the building the motor switch is turned off. As the rotation of shaft 28 and the centrifugal wheel 30 begins to slow down, the pressure differential between the opposite sides of the damper element 24 is reduced until equilibrium is reached when rotation stops. Inasmuch as there is no longer any unopposed upward pressure on the damper plate 24 it slides downwardly on its shaft 23 until its lower surface comes to rest upon and forms a seal with the resilient seat member 15 on the upper edge of conduit 13, thus closing the passage 14. There is no possibility of misalignment of the damper element 24 with the resilient seat 15 due to the positive guidance of the shaft 23 which is in close sliding fit with the damper plate, thus lateral displacement or tilting of the damper plate is minimal.

Another embodiment of the invention, shown in FIG. 2 is similar to that described above except that the guide shaft 23, rather than being mounted on plate 22 as in FIG. 1, is unattached at its lower end and its upper end is connected to the lower end of the drive shaft 28 by means of a suitable coupling member 33. In this way the rotation of the drive shaft 28 is imparted to the guide shaft 23 which is stationary in the embodiment of FIG. 1. It should be noted that the lower end of guide shaft 23, although free to rotate, extends below the plane of the opening in the top of conduit 13 to prevent disengagement of the damper plate 24 which is prevented from sliding off the lower end of the shaft 23 by coming to rest on the resilient seat 15 before this can occur. The guide shaft 23 need not be a separate element, but may be replaced by an elongated shaft 28 extending below the damper bearing 36 when the damper is in closed position.

The operation of the apparatus illustrated in FIG. 2 is similar to that of the device of FIG. 1 except that the rotation of the guide shaft 23, which is in light frictional sliding engagement with the axial opening in the central guide bushing 36 of the damper plate, induces the guide plate to rotate in the same direction as the shaft 23. Rotation of the damper plate 24, due to the light frictional contact with the rotating shaft 23, speeds up the opening of the damper since it tends to cause the damper to climb up the shaft. It has also been found that the rotation of the damper plate 24 on the guide shaft produces quieter closing of the damper since it descends more gradually into contact with the resilient seat 15. This is a very important advantage of this embodiment, since quiet operation is almost always desirable and is virtually essential in installations in theaters and other buildings where dra-

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matic or musical performances are staged, for example.

As shown in FIGS. 3 and 4, the damper element 24 may be provided with vanes 35 and/or embossments 34 to facilitate its rotation on the guide shaft 23 under the influence of the air flowing upwardly out of the conduit 13. The provision of embossments 34 or vanes 35 is especially useful with the embodiment of FIG. 1, which does not have the rotating guide shaft of the embodiment of FIG. 2, to impart the desirable rotation.

The damper element 24 may be mounted on the guide shaft in a variety of ways to provide the light frictional sliding fit which is necessary to realize the advantages of the invention. The guide bushing 36 shown in FIGS. 1, 2 and 4 may be formed of any suitable bearing material fastened to the damper plate by appropriate conventional means such as by bolts, screws, adhesives etc. Another suitable bearing is the metal wear plate and bushing 37 shown in FIG. 5, which may be composed of a metal having good sliding frictional qualities with respect to the metal of the guide shaft 23. For example the guide shaft 23 may be composed of a ferrous metal such as steel and the wear plate and bushing 37 may be composed of bronze which forms an excellent bearing when used with a suitable lubricating oil. Alternatively, the bearing may be a plastic bushing 38 as shown in FIG. 6 which has good frictional qualities with respect to the metal guide shaft 23. Suitable bushings 38 may be composed of polyamide plastics such as nylon or of fluorocarbon materials such as Teflon or other plastics known to be useful as bearing materials. Still another suitable bearing is a grommet 39 shown in FIG. 7 which may be press fitted into the axial bore hole in the damper plate 24, and which may also be composed of any suitably deformable semirigid bearing material having suitable frictional qualities with respect to the guide shaft 23.

It will be seen that the devices of the present invention provide dampers integral with a centrifugal roof exhauster which prevent flow of air from the exterior to the interior of the building in which installed when the exhaust mechanism is not in operation, but offer minimal impedance to air flow out of the building when the exhauster is in operation. The new devices are also advantageous in that they consist of self-contained units adapted to be mounted simply and easily on an existing curb ready for immediate operation. This has the advantage of abating the expensive and time-consuming installation required by similar devices of the prior art. Although the device of FIG. 1 is superior to those of the prior art in providing positive guide means for the rising and falling damper element in order to assure smooth and precise operation, the device of FIG. 2 is preferred, since it has the further advantages of increased rapidity of opening and quiet closure provided by the rotation of the damper guide shaft and damper element. Moreover, the rotation of the damper element and its associated bushing on the guide shaft 23, either under the sole influence of exhausted air as in FIG. 1, or under the added influence of a rotating guide shaft as in FIG. 2, tends to have a cleansing action on the guide shaft thus resulting in more efficient operation. This cleansing action may be facilitated by the use of felt or other flexible washers above the bushing 36 as shown in FIGS. 1, 2 and 4.

Although the invention has been described in detail in connection with specific embodiments thereof shown in the drawings, these embodiments are merely illustrative of others that will be apparent to those skilled in the art, and are not to be construed as limiting the scope of the invention which is defined in the accompanying claims.

I claim:

1. In an exhaust device including a conduit providing an air passage between the interior and exterior of an enclosed space, air impeller means motor driven through a rotary shaft for moving air out of said enclosed space

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through said conduit, and damper means movable in response to a difference in air pressure between its opposite sides between an open position permitting flow of air out of said space through said conduit and a closed position preventing flow of air into said space through said conduit, the improvement which comprises: in combination, an elongated guide shaft and means in close sliding contact therewith, said means being connected to said damper to mount the same on said shaft; whereby said shaft prevents lateral movement of said damper as it moves longitudinally along said shaft between said open and closed positions, said damper means being provided with at least one member extending therefrom whereby air pressure acting against said member causes said damper means to rotate with respect to said guide shaft.

2. A device according to claim 1, wherein said guide shaft is stationary.

3. A device according to claim 1, wherein said guide shaft is mounted for rotation about its longitudinal axis.

4. A device according to claim 1, wherein said guide shaft is stationary and is mounted on a member spanning the air passage of said conduit, said damper means is a concavo-convex plate, said means in close sliding contact with said shaft is a centrally located bearing member provided with an axial bore therethrough, said damper is mounted with its convex side toward the interior of said space, said conduit is provided at its exterior end with a seating surface disposed in a plane normal to the axis of said shaft, and wherein said damper plate when in open position is spaced from said seating surface and when in closed position has its convex surface in contact with said seating surface, whereby said bearing member and guide shaft prevent tilting of said damper plate thus assuring positive seating of said damper plate in the closed position.

5. A device according to claim 4, wherein said seating surface is covered with a resilient material.

6. In an exhaust device including a conduit providing an air passage between the interior and exterior of an enclosed space, air impeller means motor driven through a rotary shaft for moving air out of said enclosed space through said conduit, an elongated guide shaft, and damper means mounted on said guide shaft and movable in response to a difference in air pressure between the opposite sides thereof between an open position permitting flow of air out of said space through said conduit and a closed position preventing flow of air into said space through said conduit, the improvement wherein said guide shaft is mounted for rotation about its longitudinal axis and rotary motion is imparted thereto by means of the motor driven rotary shaft of said air impeller means, said damper means is a concavo-convex plate having a centrally located bearing member provided with an axial bore therethrough, said damper is mounted with its convex side toward the interior of said space and with its axial bore in close sliding contact with said guide shaft, said conduit being provided at its exterior end with a seating surface disposed in a plane normal to the axis of said shaft, and wherein said damper plate when in open position is spaced from said seating surface and when in closed position has its convex surface in contact with said seating surface, whereby said bearing member and guide shaft prevent lateral movement and tilting of said damper plate thus assuring positive seating of said damper plate in the closed position and accelerated movement of said damper plate to open position by imparting rotation thereto by frictional contact between the bearing member and rotating guide shaft.

7. A device according to claim 6, wherein the convex surface of said damper plate is provided with at least one member extending therefrom, whereby air pressure acting against said member will tend to aid rotation of said damper plate.

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8. A device according to claim 6, wherein said seating surface is covered with a resilient material.

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