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[56]

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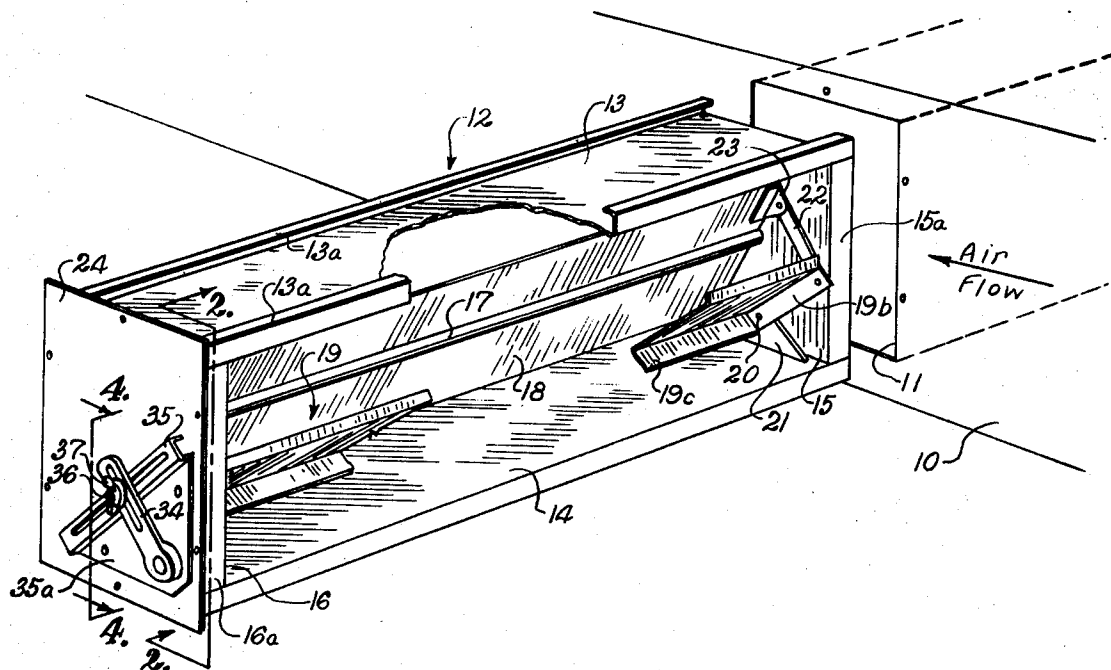
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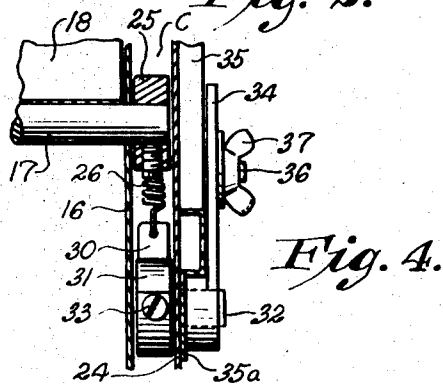
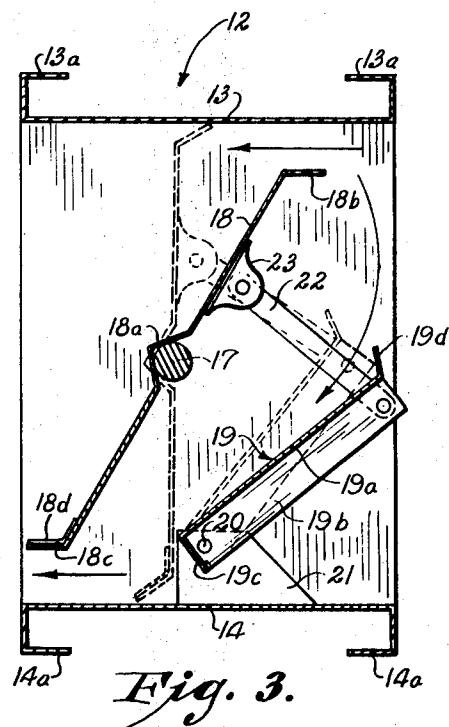
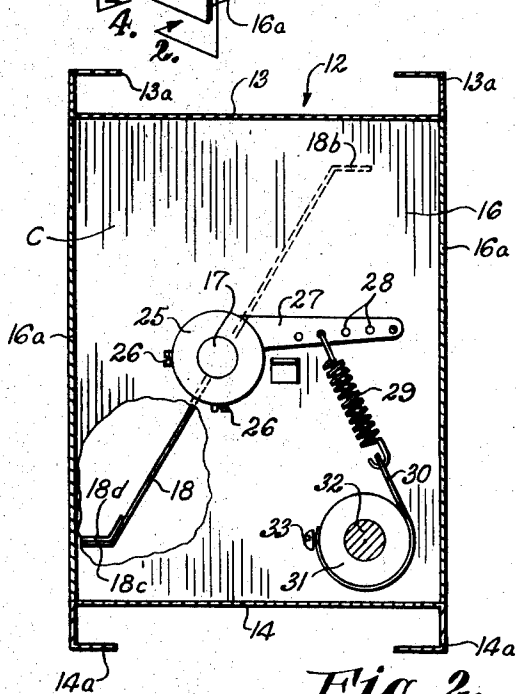
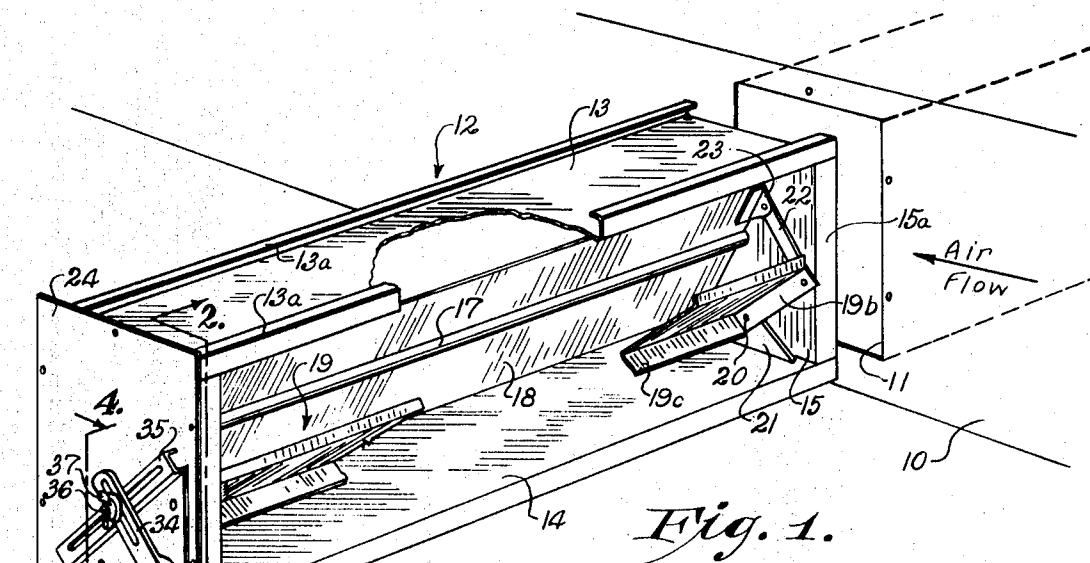
[54] CONSTANT VOLUME REGULATOR FOR AIR DUCT SYSTEMS

8 Claims, 4 Drawing Figs.

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137/521; 267/1; 98/110
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F16f 1/12; F24f 13/10
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(BG)

ABSTRACT: A pivotal butterflylike valve is interposed in the air duct. Upstream of the valve is a pivotal sail member which is connected by a link to one wing of the valve. The sail is permanently biased toward an open position for the valve and as the velocity pressure differential ahead of the valve increases, the sail tends to close the area through the valve structure open to flow, the degree of closure being determined by the amount of the change in pressure differential.





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CONSTANT VOLUME REGULATOR FOR AIR DUCT SYSTEMS

SUMMARY OF THE INVENTION

In multiple outlet air-conditioning systems, particularly those of forced air, high velocity type, it is desirable to provide for substantially constant volume flow through each outlet or group of related outlets. This is, however, difficult to build into the system, since individual controls within certain areas may be opened or shut down at various times, thus decreasing or increasing, as the case may be, the back pressure between those outlets and the central fan. When the pressure changes, the flow rate through the remaining outlets changes even though this is not desirable.

Another situation where such a control is needed is in a double duct system having hot and cold ducts which feed into a common discharge or outlet duct assembly. The temperature of the mixture is controlled by increasing or decreasing flow through one of the supply ducts and this obviously changes the total pressure and unless controlled, the volume at discharge.

Generally summarized, my invention provides a symmetrical butterflylike valve member which is interposed in the discharge duct and which is linked with a sail member disposed upstream of the valve member. The sail is positioned so as to be influenced by the velocity pressure. The sail member is movable within the duct and is resiliently biased toward the direction that air flows from, thus tending to urge the valve member toward its full open condition. The biasing force is adjustable through the medium of an external control, thus making it possible to select different volumetric flow rates for given pressures. The unit embodying the invention can be placed in a duct in either of two relatively inverted positions without affecting its main operation.

The principal advantages and objects achieved by my invention are the provision of a volume regulator which relies substantially on velocity pressure alone for its closing action and not the total air pressure; the relative simplicity of structure, which is instrumental in making it available at low cost; the sensitive nature of the operation; the ready and facile adjustability of the control tension to change the desired flow rate; and the construction of the unit for easy insertion into and removal from a duct with the inversion capability noted earlier.

Other and further objects of the invention, together with the features of novelty appurtenant thereto will appear in the course of the following description.

DETAILED DESCRIPTION

In the accompanying drawings, which form a part of and are to be read in conjunction with the specification, and in which like reference numerals indicate like parts in the various views:

FIG. 1 is a perspective view showing a fragmentary side portion of a typical air duct and a constant volume regulator embodying the invention in its preferred form, the regulator being shown as removed from the duct, and parts of the regulator structure being broken away for purposes of illustration;

FIG. 2 is an enlarged sectional view taken generally along line 2-2 of FIG. 1 in the direction of the arrows, i.e. just inside the end plate for the unit;

FIG. 3 is a vertical section taken in a plane parallel to section line 2-2, substantially at the midpoint of the unit; and

FIG. 4 is a fragmentary enlarged section taken along line 4-4 of FIG. 1 in the direction of the arrows.

Referring to the drawing, reference numeral 10 indicates generally a typical air flow duct such as may be found in any high velocity air-conditioning system. Conventionally, such a duct is made of sheet metal and is rectangular in cross section. The near sidewall of the duct in the illustrated embodiment is provided with a rectangular opening 11 which provides access to the duct for the volume regulator 12.

The regulator 12 is constructed to have a horizontal top wall 13 and bottom wall 14 defining a space therebetween. The space is closed at opposite ends by the end walls 15 and 16. The top wall and bottom walls 13 and 14 are preferably formed as sheet metal sections having the reversely bent flange portions 13a and 14a. The flanges 13a and 14a serve as runners or skids for supporting the unit when it is slid or inserted into the duct. Additionally, they provide structural ribs which serve to strengthen the overall unit in a longitudinal direction. The end walls 15 and 16 may be the webs of channel cross section members having out-turned flanges 15a, and 16a on each side. The end wall and top and bottom wall sections can be joined with one another in any convenient fashion, as by welding.

Centrally mounted between and journaled in the end walls 15 and 16 of the regulator housing is a horizontal shaft 17 which has affixed thereto the rectangularly shaped butterflylike valve member 18. The valve member 18 is secured to shaft 17 by means of the V-shaped offset 18a which matches with the shaft and is welded or otherwise secured thereto. It will be noted that the length of valve member 18 is substantially the distance between the end walls 15, 16, leaving enough clearance for free pivotal action of the valve member. The width or height of the valve member is substantially equal to the spacing between the top and bottom walls. Preferably, the upper and lower edges of the valving member are provided with offset flanges 18b, 18c. For reasons later to be set forth, the lower flange 18c has mounted thereon a counterweight 18d.

Positioned on the upstream side of the valve member 18 is what I have defined as a sail member 19. This member has the planar main body 19a whose length is substantially equal to the width of the casing and which has the back turned flanges 19b at opposite ends. A bottom flange 19c extends between the end flanges 19b. The upper edge of the sail member is bent to provide an inclined flange 19d which is bent in the direction of air flow. The sail member is pivotally supported for swinging movement about an axis defined by a pair of pivot pins 20 (only one of which is seen in FIGS. 1 and 3). It will be understood that at the end concealed from view in FIG. 1, there is a similar pin 20 which connects with the end flange 19b at that end. Pins 20 are journaled in brackets 21 secured to the bottom wall 14 and extending upwardly therefrom.

Each end of sail member 19 has connected therewith a link 22 which extends forwardly from the sail member to pivotally connect with a bracket 23 secured to the upper wing portion of the valve member 18. Again, while only one such link and bracket are shown in FIG. 1, it will be understood that there are two such arrangements, one at each end. Link 22 is pivotally connected with the end flange 19b so as to provide an articulated connection between the sail and the valve member.

The sail is generally inclined with respect to the air flow in the same direction as the valve member 18.

Positioned on the near end of the unit as viewed in FIG. 1, is an end plate 24 which defines with the end wall 16 and side flanges 16a a compartment C in which is located the structure shown generally in FIGS. 2 and 4.

The end of shaft 17 extends into the compartment C and has mounted thereon a collar 25 which is adjustably secured on the shaft by means of the setscrews 26. Projecting substantially radially from the collar is an arm 27 provided along its length with a plurality of spaced perforations or apertures 28.

The perforations 28 provide adjustable mounting points for a hook at one end of a tension spring 29. The other end of spring 29 is similarly connected with one end of a flexible strap 30 which is wrapped partially around a cylindrical or annular collar 31 which is keyed or otherwise secured to a shaft 32. The shaft 32 is journaled in the plate 24 and extends outwardly therethrough. Strap 30 is secured to the collar by the screw 33.

Secured to shaft 32 on the outside of the end plate 24 is the radial arm 34, this arm extends upwardly and across the chan-

nel-shaped bar portion 35 formed as part of a reinforcing plate 36 which is riveted to the end wall 24. As can best be seen in FIG. 1, the arm 34 and bar 35 are longitudinally slotted and the slots intersect one another. Interconnecting the arm 34 with the bar 35 is a bolt 36 having a head (not shown) within the channel formed by the bar 35 and a wingnut 37 on the outside by which the arm 34 can be tightened against and immobilized with respect to the bar 35. Obviously, by backing nut 37 off away from arm 34, the arm can be pivoted upwardly or downwardly, thus to change the tension in spring 29, since pivoting of the arm results in rotation of the cylinder 31 to which the flexible strap 30 is connected.

In operation, the valve member 18 will normally be in a position similar to that illustrated in FIG. 2, i.e. one which permits air to flow through the duct. The arm 34 will be adjusted to a particular angular position which results in a clockwise moment on the valve member 18 which balances the counterclockwise moment resulting from the force exerted against the sail member 19 by the velocity pressure in the duct. Obviously, so long as the valve member 18 remains in an open position, static pressure on opposite sides thereof will be substantially equal and since the valve member 18 is symmetrical with respect to its axis 17, the main force tending to turn the valve member 18 counterclockwise will be the velocity pressure acting on the sail member 19.

One of the great advantages of my invention is that it provides a volume regulator in which the velocity pressure is the principal and substantially only variable which acts upon the valve tending to close it or resisting the tendency of the spring 29 to reopen it. Other regulators of which I am aware rely upon the total pressure differential across the valve with the result that once the valve is closed it is quite difficult to reopen. In my structure, the balanced butterfly-type arrangement eliminates total pressure as a factor since the more closed it becomes the lesser the velocity pressure and thus the lesser the force acting on the sail member tending to close the valve. For normal flow variations, the valve is not likely to close and even if it does, the balanced static pressure above and below the pivot axis 17 permits quick reopening under the influence of the spring 29.

The influence of spring 29 on the valve member can be altered by shifting its attachment point inwardly or outwardly on the arm 27 and also by resetting of the collar 25 with respect to shaft 17. The counterweight 18d serves to balance out the moment created by arm 27 and serves to normally maintain the valve in a position in which it is extending in a generally transverse condition across the interior of the housing. In other words, the counterweight 18d serves to impose a minimum counterclockwise moment which will overcome the moment created by arm 27 and the spring 29 and strap 30, thus maintaining the spring 29 even when no air is flowing through the duct in a position ready to be influenced by the flow.

The assembly can be inserted and removed as desired from the duct and as noted earlier can be inserted either in the orientation shown in FIG. 1 or the inverse thereof. In this connection, counterweight 18d should not be so heavy as to overcome the additional moment which, in the inverted position, will be imposed by the gravity force of the sail member acting against the valve member.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawing, is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. Fluid flow control means comprising:

a duct having an upstream and a downstream end;

a valve member swingably supported along its central portion for swinging movement in the duct between a closed and an open position, the edges of said valve member on opposite sides of said central portion lying near opposite sidewalls of the duct in the closed position of the valve member;

a substantially inflexible velocity pressure-sensing sail member positioned on the upstream side of said valve member and having a fluid-intercepting surface, said sail member supported for swinging movement in the lengthwise direction of the duct and toward and away from said central portion of the valve member;

biasing means biasing said valve member toward the open position whereby to resiliently resist displacement of said valve member toward the closed position; and

link means interconnecting said valve member and sail member whereby swinging movement of said sail member in response to changes in velocity pressure is accompanied by swinging movement of said valve member.

2. Fluid flow control means as in claim 1, said sail member comprising a vane within said duct supported for pivotal movement about an axis extending transversely with respect to the duct.

3. Fluid flow control means as in claim 1:

said valve member comprising a valve plate and mounting means supporting said plate for pivotal movement about an axis extending transversely of and bisecting a cross section of said duct; and

said sail member connected by said link means with said plate on one side of said axis.

4. Fluid flow control means as in claim 1, said biasing means including:

an arm connected with said valve member for applying a swinging moment to said valve member;

an adjustable anchor member; and

resilient tension means extending between and secured respectively to said arm and anchor member, said anchor member adjustable to vary the force applied to said arm by said tension means.

5. Fluid flow control means as in claim 4:

said anchor member comprising a rotatable member and a flexible strap having one end connected therewith and windable thereon, said tension member connected with the other end of said strap; and

locking means for releasably securing said rotatable member against rotation through a range of settings therefor.

6. Fluid flow control means as in claim 5:

said locking means including an arm secured to and extending radially from said rotatable member, a stationary locking bar extending transversely with respect to and adjacent said arm, each of said plate and arm including an elongate slot extending lengthwise thereof; and releasable fastener means adjustable lengthwise of said slots and interconnecting said arm and bar.

7. Fluid flow control means as in claim 1, said biasing means including:

a member connected with said valve member for applying a swinging moment to said valve member;

means connected with said last-named member and resiliently urging the valve member toward the open position therefor; and

control means connected with the last-named means operable independently of movement of the valve member to vary the strength of the force applied to the valve member thereby.

8. Fluid flow control means as in claim 7, said control means including a pivotal arm located exteriorly of said duct.