

VALVE FOR AIR-CONDITIONING SYSTEM

The present invention relates to a variable volume valve for use in a gas flow system such as an air-conditioning system, which typically will comprise a number of separate ducts and outlets and valves are provided at suitable locations to close or partially close the duct to restrict air flow according to the demands of the system.

One known form of variable volume valve is known as a butterfly valve and comprises a simple circular plate mounted on a pivotal shaft extending in the plane of the plate and adapted to be driven so as to vary the valve's position relative to the circular duct in which it is mounted. Another known system utilises two apertured plates which are slidable or otherwise displaceable relative to one another to vary the degree of overlap of the apertures thereby varying the cross-sectional area of the duct and in this way the air flow is controlled.

Particularly for air-conditioning systems it is desirable to manufacture economically a variable volume valve which can readily be adjusted for example by an automatic control system and, particularly in the fully opened position, will generate the minimum amount of noise and produce a very low pressure drop. The present invention is concerned with new and useful alternatives to previous proposals and it is believed that in at least preferred embodiments will provide a structure which is inexpensive to manufacture, durable and reliable and most importantly will generate little noise when in use.

According to the present invention, there is provided a variable volume valve for use in a rectangular duct of an air-conditioning system or the like and comprising (a) first and second valve members each being pivotal around an axis which in use is arranged to extend across a duct and (b) each valve member having a convex surface when viewed at right angles to the pivot axis, the convex surface being presented towards the air flowing along the duct, in use, (c) each valve member extending from its pivot axis in a downstream direction along the duct, (d) actuating means provided for displacing the respective valve members towards or away from one another so as to move between open and closed positions of the valve, (e) the actuating means being located in a zone generally between the valve members and comprising a rotatable shaft extending across the valve duct and adapted to be rotated when in use, (f) the shaft carrying a pivotal linkage which is pivotally connected to the respective valve members, (g) the valve members being arranged to guide air flowing along the duct such that the air does not interact with the actuating means, and (h) each valve member having an elongated surface for contacting a wall of the duct in the closed position.

Preferably, the valve members are hingeably interconnected through a common hinge which extends generally centrally across the valve duct so that the embodiments are possible including the valve members having separate hinge connections to a connecting element.

In a preferred embodiment, the actuating means operates symmetrically to displace the valve members by substantially the same amount in opposite directions whereby a symmetrical valve structure is provided. However, the invention also extends to embodiments which are not symmetrical and it is also possible for the valve members to be actuated so as to move by different amounts.

The invention extends to a valve when mounted in such a valve duct. Preferably, the duct is of rectangular cross-sectional shape, each valve member having lateral edges which in use are disposed adjacent opposite side walls of the valve duct and a distal portion of each valve member extends transversely across the duct and in the fully closed position of the valve lies adjacent to or in abutment with a wall of the duct disposed at right angles to the opposite side walls.

In general terms, at least a preferred embodiment is one in which the valve members cooperate in a clam-like form with the actuating means located inside the clam shape.

Preferably, each valve member is of curved form for example generally air foil in shape or, for maximum economics of manufacture, may comprise a series of flat panel portions which are integrally formed and connected by bends at spaced points.

Any suitable form of actuating means can be adopted, but a preferred and advantageous mechanism is one comprising a shaft arranged to extend laterally across

the valve duct and between the valve members, a rocker arm being fixed to the shaft and rotatable therewith and pivotal links are linked to respective ends of the rocker arm and to respective portions of the valve members whereby rotation of the rocker arm in a first direction moves the valve members towards each other and contrary rotation moves the valve members away from one another and to the closed position of the valve.

Advantageously the valve duct is mounted in a main duct of greater transverse dimension and extending in the downstream direction whereby noise generation is substantially avoided. For example, with a valve duct having a traverse dimension of the order of 200mm, the main duct has a traverse dimension of about 300mm. In other words a space of about 50mm has been found advantageous between the periphery of the valve duct and the interior of the main duct.

The invention extends to an air-conditioning system including a multiplicity of ducts including strategically placed variable volume valves each adapted to be driven by an electrically or pneumatically powered actuator, and the system having a control device for sensing air flow requirements and providing appropriate actuation signals to control the system.

For illustrative purposes only an embodiment of the invention will now be described with reference to the accompanying drawings, of which:-

Figure 1 is a schematic cross-sectional side elevation through an embodiment of variable volume valve in a closed position;

Figure 2 is a cross-sectional view corresponding to figure 1, but showing the valve in an open position and omitting the actuating linkage for the purpose of clarity;

Figure 3 is a plan view of the valve of figure 1 and 2 and omitting for clarity valve blades and linkages; and

Figure 4 is a view on a reduced scale in section and schematically illustrating the valve mounted in a main

duct.

As will be best seen from figure 1, the valve comprises a rectangular duct 10 having side walls 11, a top wall 12 and a bottom wall 13, and mounting a pair of valve blades namely upper blade 15 and lower blade 16, which are pivotally interconnected at an upstream interengagement position on a hinge pin 17A. Each valve blade is generally arcuate, but pressed from a flat panel with bends 17, 18 and 19 and terminating in a lip 20 at its free end. Each valve blade has a centrally located lug 22 which is connected pivotally through a linkage 23, and which in turn is pivotally attached to a respective end of a rocker arm 24 fixed to a main mounting rod 25.

As shown in figure 3, the mounting rod 25 extends right through the duct and is pivotally mounted on nylon bushes 27. The rod is adapted to be rotated by an electric or pneumatic actuator controlled in a conventional manner and responsive to conventional devices such as switches or thermostats.

It will be seen that rotation of the rocker arm in an anti-clockwise direction when viewed as in figures 1 and 2 causes the valve blades to move to be adjacent to one another and the profile is such that a close approximation of an airfoil shape is achieved, whereby a low pressure drop across the device is provided with only a low degree of noise generation.

In a typical embodiment, the valve duct has a rectangular shape with a height of 200mm across the duct and as shown in figure 3 this is mounted in a larger dimensioned discharge duct 28, which preferably includes about 25mm of acoustic insulation 29 in the wall. A spacing of about 50mm from the edge of the valve duct to the discharge duct has been found to be most beneficial in avoiding generation of noise.



CLAIMS

1. A variable volume valve for use in a rectangular duct of an air-conditioning system or the like and comprising (a) first and second valve members each being pivotal around an axis which in use is arranged to extend across the duct (b) each valve member having a convex surface when viewed at right angles to the pivot axis, the convex surface being presented towards air flowing along the duct, in use, (c) each valve member extending from its pivot axis in a downstream direction along the duct, (d) actuating means provided for displacing the respective valve members towards or away from one another so as to move between open and closed positions of the valve, (e) the actuating means being located in a zone generally between the valve members and comprising a shaft extending across the valve duct and adapted to be rotated when in use, (f) the shaft carrying a pivotal linkage which is pivotally connected to the respective valve members, (g) the valve members being arranged to guide air flowing along the duct such that the air does not interact with the actuating means and (h) each valve member having an elongated surface for contacting a wall of the duct in the closed position.

2. A valve as claimed in Claim 1, wherein the valve members are hingeably interconnected about a common hinge having a common hinge axis which extends generally centrally across the valve duct when in use so that the pivot axes of the valve members coincide.

3. A valve as claimed in Claim 1 or Claim 2, wherein the valve members are mounted to be displaced by the actuating means to a substantially equal and opposite extent and the valve members define a



substantially symmetrical structure viewed at right angles to the pivot axis of each of the valve members.

4. A valve as claimed in any one of the preceding claims, wherein the pivotal linkage comprises a rocker arm pivotally connected to respective links which are connected to the respective valve members.

5. A valve as claimed in any one of the preceding claims, wherein each valve member comprises a sheet bent to form a profile which is an approximation of an air foil shape.

6. A valve as claimed in Claim 5, wherein a distal portion of each valve member has a substantially flat surface adapted to come into abutment with or lie adjacent a corresponding flat wall of the duct when the valve is in the fully closed position.

7. A valve as claimed in any one of the preceding claims, wherein the first and second valve members are constructed to be of clam-like form.

8. A variable volume valve as defined in any one of the preceding claims when mounted in a valve duct.

9. A variable volume valve as claimed in Claim 8, wherein the valve duct is mounted in a main duct of greater transverse dimension and extending in the downstream direction whereby noise generation is substantially avoided.



10. A variable volume valve as claimed in Claim 9, wherein the main duct has a transverse dimension approximately 50% greater than the transverse dimension of the valve duct.
11. A variable volume valve for an air-conditioning system substantially as hereinbefore described with reference to the accompanying drawings.
12. An air-conditioning system having a multiplicity of the ducts, at least some of which incorporate a variable volume valve as claimed in any one of Claims 8 to 11, each of the variable volume valves being adapted to be driven by a powered actuator in response to a control device for the system, the control device operating to sense air flow requirements and provide appropriate actuation signals.