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(54) Improvements relating to ventilators.

(57) A sprung to open hinged flap ventilator having an opening spring (40) in the form of a linearly extendible strut the effective radius of action of which increases as the flap is moved from its closed to its fully open position, the strut being composed of a series of springs (40) of different linear spring rates.

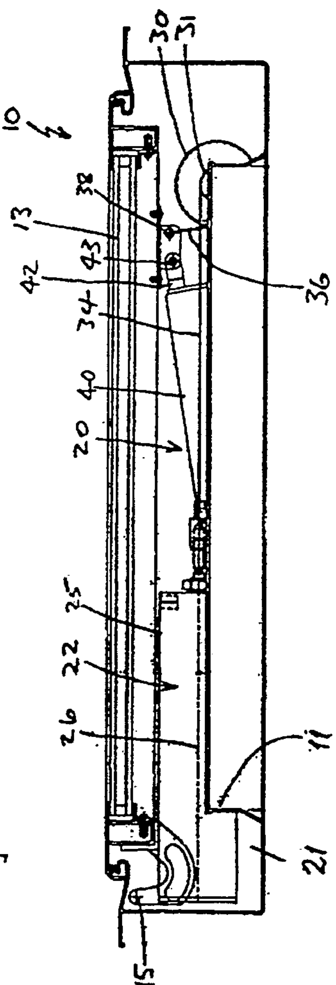

Fig 1

EP 0 430 720 A2

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IMPROVEMENTS RELATING TO VENTILATORS

The present invention comprises improvements relating to ventilators and concerns controllable ventilators comprising an outwardly opening hinged flap which when closed covers over and closes or assists in closing a ventilation opening of the ventilator.

Such ventilators are often used as fire ventilators and, to ensure a failsafe operation, are provided with a flap opening spring or springs. For normal day-to-day ventilation the flap is opened by its spring and closed against the action of its opening spring by means of a fluid pressure operable piston and cylinder unit or an electric motor, for example.

Since the opening spring is required to open the flap in all circumstances it is usual to make proper allowance for the weight of the flap, any snow load on the flap and the frictional forces of the mechanism which need to be overcome when moving the flap from its closed, e.g. horizontal, position to its open, e.g. vertical, position, when choosing the power of the opening spring.

It will be understood that the horizontal closed and vertical open position of the flap are chosen to represent the worst example concerning the opening force requirements for the flap and that the ventilator might well be mounted at some inclined angle or even vertically in practice instead of horizontal.

However, in any orientation of the ventilator, an equal and opposite power is, in general, required to be exerted on the flap to move the flap from its, e.g. vertical open position to its horizontal closed position ignoring the self weight of the flap. The closing force determines the stress regime to which the ventilator frame is subjected during the closing of the flap and any reduction of this stress is of benefit to the design and functioning of the ventilator as a whole.

Taking a single hinged flap ventilator mounted in a horizontal position as an example and referring to Fig. 2 of the accompanying drawings, it may be seen that the torque required to open the flap is $W \cos \alpha \frac{H}{2}$ where W is the weight of the flap, H is the length of the flap and α is the opening angle which changes from 0° to 90°. This torque is at a maximum when the flap is horizontal and a minimum when the flap is vertical, as indicated by the curve d in Fig. 3 of the accompanying drawings. To this must be added the snow load and friction load allowance. The expected torque to open the flap is as indicated by the curve e shown in Fig. 3.

The opening torque characteristic due to the force exerted by the opening spring must start above this curve e. If the opening spring is to be in the form of a linearly extendable strut housed generally within the depth of the ventilator frame, however, then as may be seen from Fig. 2 the effective radius of action about the flap hinge axis at which the spring operates on the flap increases from b to e as the flap is moved from its closed to its open position. The opening torque characteristic thus rises with the opening angle α, generally as indicated at g in Fig. 3 and the torque required to close the flap, taking into account the assistance of the flap self weight, is indicated at f in Fig. 3.

The present invention aims to reduce the maximum closing torque requirement in a sprung-to-open hinged flap ventilator having an opening spring in the form of a linearly extendible strut the effective radius of action of which increases as the flap is moved from its closed to its fully open position.

To this end the present invention provides that the strut is composed of a series of springs of different linear spring rates.

A specific embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which :

FIG. 1 is a cross section of a single flap ventilator of the present invention in a closed position ;

FIG. 2 is a cross section of the ventilator in an open position ; and

FIGS. 3 and 4 are diagrams.

With reference now to the accompanying drawings, the ventilator comprises a frame 10 defining a ventilation opening 11 and a single, glazed ventilation flap 13 hinged to the frame and angularly movable about its hinge axis 15 to open and close the ventilator.

Mechanism generally indicated at 20 is provided for opening and closing the ventilator and one such menchanism is housed in each longitudinally extending internal side channel 21 of the frame. The mechanisms 20 are identical and one only of them will be described.

The mechanism 20 comprises a pneumatic piston and cylinder unit 22 having its cylinder 25 mounted to the frame 10 with its cylinder inner end positioned in the side channel 22 adjacent the flap hinge axis 15 and its cylinder axis 26 extending longitudinally of the side channel 21. Rotatably mounted towards the opposite end of the side channel 21 is an integral pair of drums 30, 31 of different diameter. The smaller diameter drum 31 receives a wound-on end portion of a flat high tensile flexible steel strip 34 connected at its other end to the piston rod 23 of the piston of the piston and cylinder unit 22. The larger diameter drum winds on one end of a wire rope or a further flexible steel strip 36, the other end of which is connected to the flap 13 as at 38.

A pair of linearly operable gas springs 40 are fixed together in parallel, side-by-side, so as to overlap their linearly operable extents. The gas springs 40 have their piston rods 42 extending in opposite directions and hingeably connected at their outer ends respectively to the flap 13, as at 43, and the frame 10, as at 44, in this case by means of ball joints 45. Instead of side-by-side gas springs 40 a pair of telescoping gas springs, one housed within the other, could be used. Again, cylinder guided, coiled wire torsion springs could be substituted. However, linearly operable gas springs are preferred.

The gas springs 40 operate as linearly extendible struts to open the ventilator and the ventilator is closed by fluid pressure supplied to the piston and cylinder units 22.

As will be appreciated, the overall length of the cylinders 25 is dependent upon their stroke length and a fixed dimension for internal seals, piston and end mountings. Thus, the overall outstroked length of the piston and cylinder units 22 is at least twice their stroke length. By using the different diameter drums 30, 31, the stroke length of the units 22 is magnified to an extent sufficient to close the ventilator flap whilst positioning the connection points 38 of the flexible connection members 36 at a location close to the connection points 43 of the gas springs 40 and close to the free transverse edge of the flap 13.

The arrangement thus achieved gives rise to a favourably low stress distribution in an otherwise compact mechanism. Further, this outcome is assisted by the use of the back-to-back gas springs 40 which have an increased outstroked to instroked length ratio enabling them to be accommodated, in their instroked condition, in front of the units 22 in the side channels 21 and between the units 22 and the drums 30, 31 as clearly seen in Fig. 3

Also, by use of high tensile flexible steel strip 34, 36, the acceptable diameter of winding and, therefore, the acceptable diameter(s) of the drum(s) 30, 31 is/are reduced.

The gas springs 40 of each pair are pressurised with gas to provide the springs of each pair with different spring rates. In particular, the lowest force of the higher pressure spring of the pair is selected to be above the highest force of the lower pressure spring of the pair. As a result, the higher pressure spring of the pair outstrokes first to move the flap 13 from its closed to a partly open position indicated at α_1 in Fig. 4 and then the lower pressure spring of the pair outstrokes to move the flap 13 from is α_1 position to its α_2 position is indicated in Fig. 4.

Conveniently the struts formed by the pairs of springs 40 are arranged to extend symmetrically, the springs 40 anchored to the frame 10 being the higher pressure springs and extending first.

The torque required to overcome the weight of the flap 13 and open the flap 13 is $W \cos \alpha \frac{H}{2}$ where W is the weight of the flap 13, H is the length of the flap 13 and α is the opening angle of the flap 13. This torque is at a maximum when the flap 13 is horizontal and at a minimum when the flap is vertical as indicated by the curve d in Fig. 4. To this must be added a snow load and friction load allowance which increases the opening torque requirement to e indicated in Fig. 4.

The maximum torque required to be exerted by the piston and cylinder unit 22 during closing of the flap 13 is indicated at f_1 in Fig. 4. This maximum occurs at the angle $\alpha = \alpha_1$.

Examination of Fig. 4 will show that this maximum torque requirement is substantially reduced.

Fig. 4 is drawn for the case of a ventilator mounted with its flap 13 disposed at an angle of 15° to the horizontal when closed and 55° to the horizontal when open, i.e. $\alpha_2 = 55°$. For the more general case with a flap 13 required to open from 0° to 90° the curve g in Fig. 4 would commence as shown in Fig. 3 and drop down vertically at the α_1 angle of opening.

Clearly, using a multispring arrangement of opening springs employing a series of more than two springs, the curve g would step down in more than one step but would still remain always above the curve e.

Instead of providing two mechanisms 20 one only may be used, housed as illustrated in one of the longitudinally extending internal side channels 21 of the frame. In order to ensure a symmetrical pull on the flap 13 the connection point at 38 of the other end of the wire rope or steel strip 36 is shifted to a point close to the mid point of the free edge of the flap 13. The wire rope is then led from the larger diameter drum 30 over a pulley on the frame, the axis of rotation of the drums 30, 31 extending at right angles and the drums being drivingly interconnected by means of a pair of bevel gears.

Claims

1. A sprung-to-open hinged flap ventilator having an opening spring in the form of a linearly extendible strut the effective radius of action of which increases as the flap is moved from its closed to its fully open position, the strut being composed of a series of springs of different linear spring rates.

2. A ventilator as claimed in claim 1 in which the springs are gas springs, the pressure of gas in one of which, when fully outstroked, is higher than the pressure of gas in another of the springs when fully instroked.

3. A sprung-to-open hinged flap ventilator substantially as hereinbefore described with reference to, and as illustrated in, Figs. 1 and 2 of the accompanying drawings.

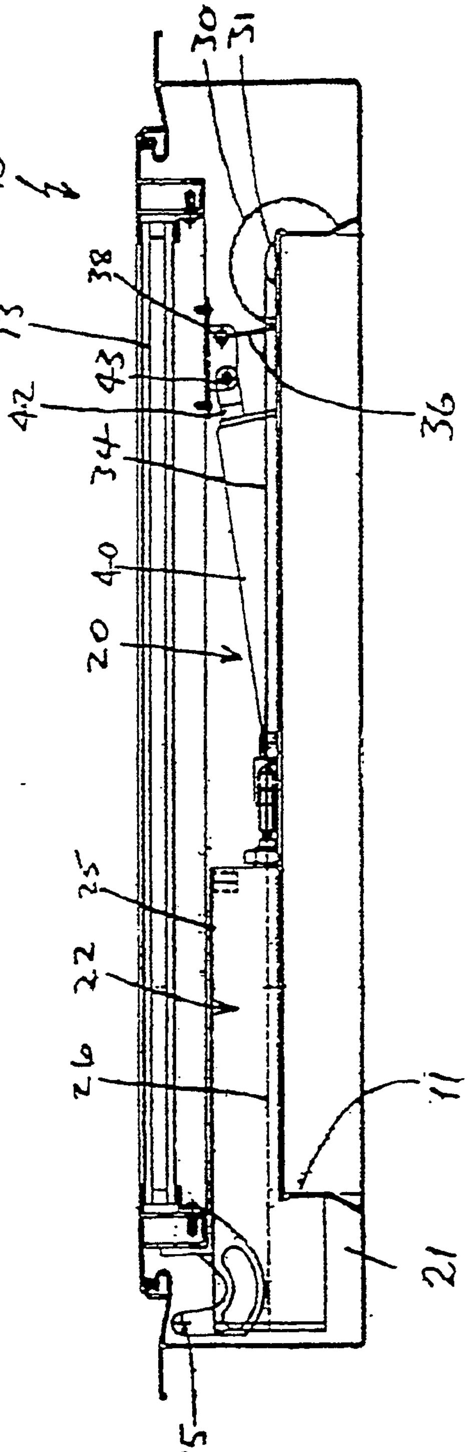


Fig 1

Fig 2.

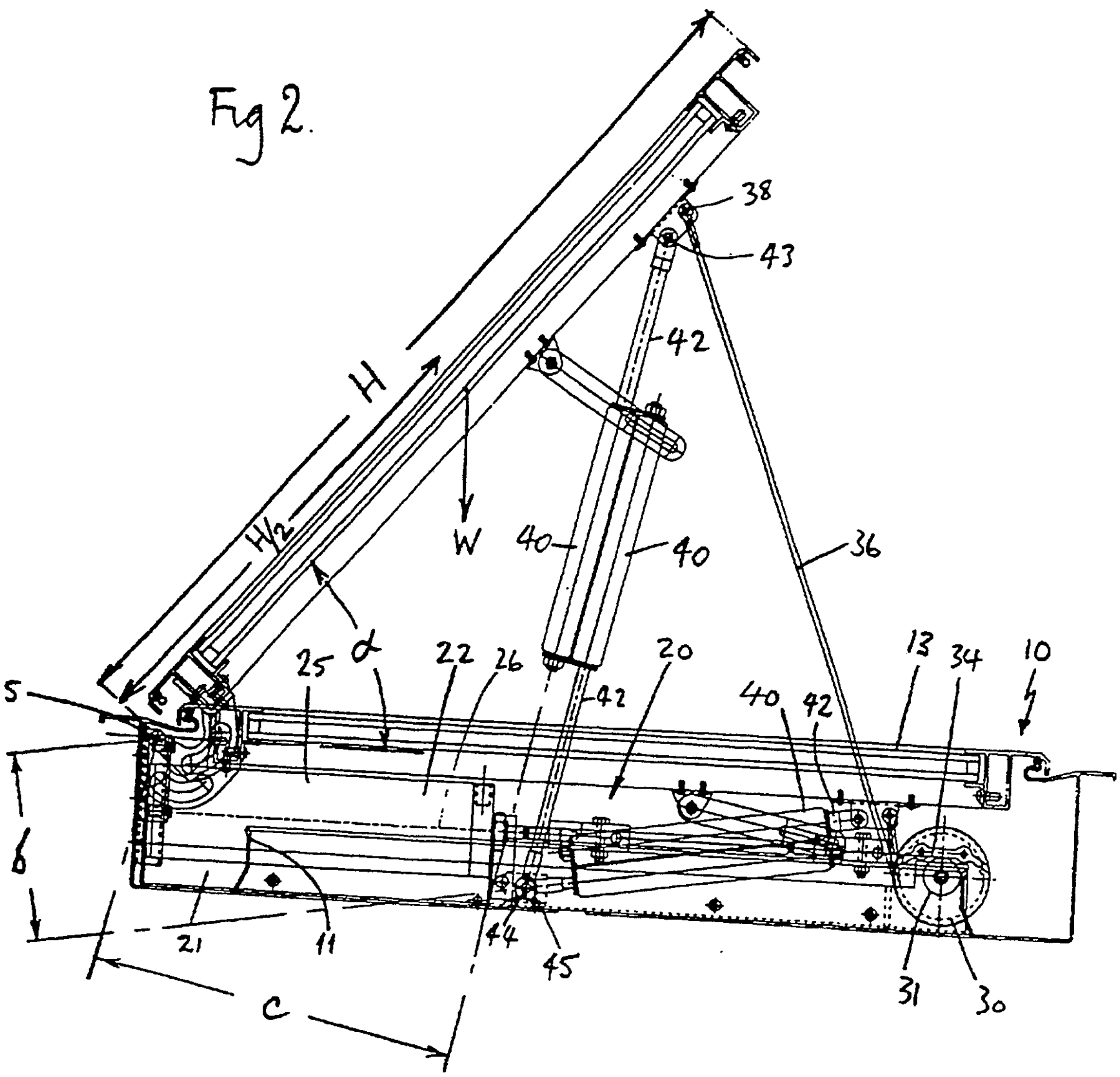

H
H/2
W
α
38
43
42
40
40
36
15
25
22
26
20
13
34
10
40
42
42
b
21
11
44
45
31
30
c

Fig 3

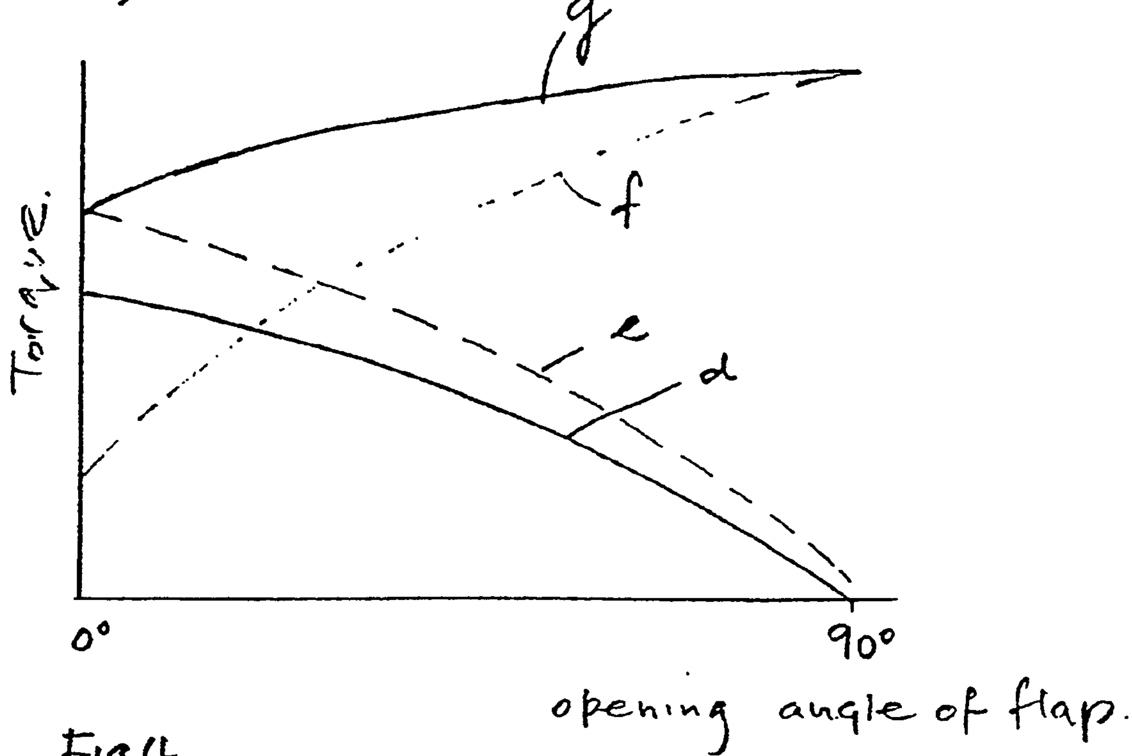
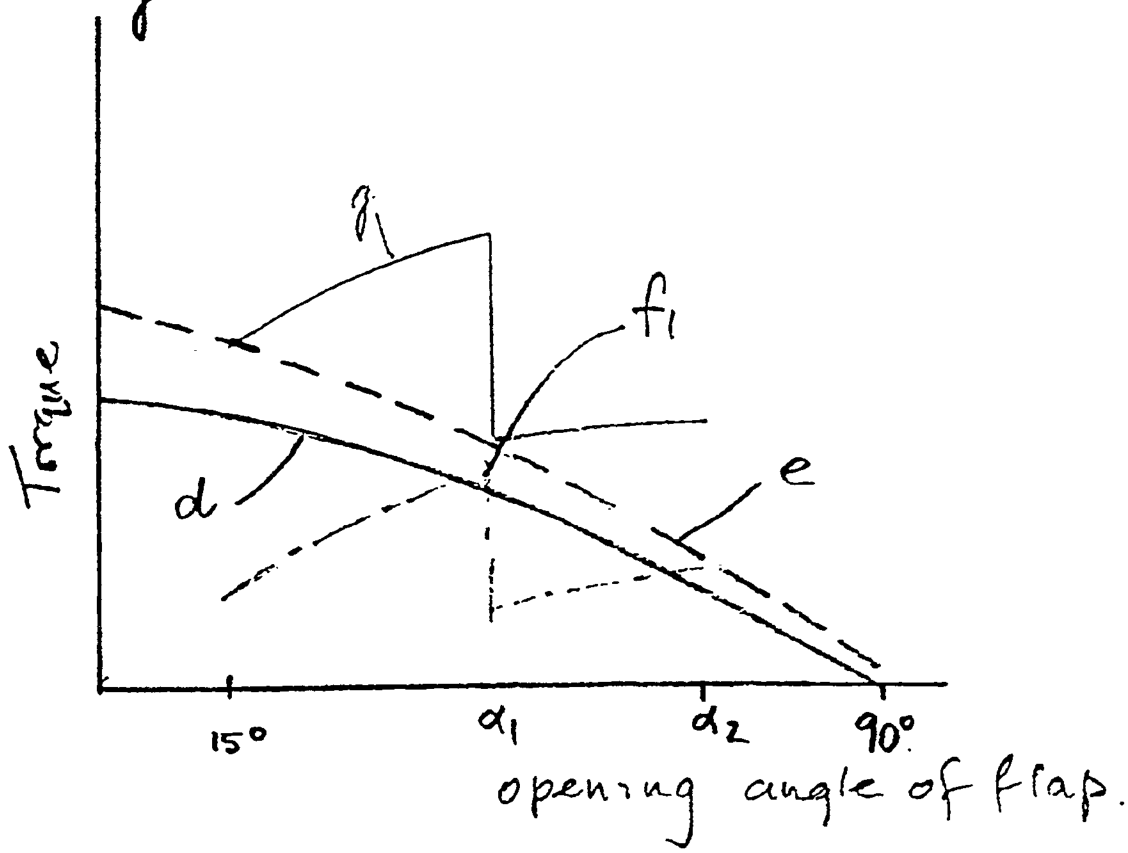

g
f
e
d
Torque
0°
90°
opening angle of flap.

Fig 4


g1
f1
e
d
Torque
15°
α1
α2
90°
opening angle of flap.