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**EP-A- 0 314 201  
DE-A- 2 633 123  
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FR-A- 2 578 017  
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## Description

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  $\alpha$  is the opening angle which changes from  $0^\circ$  to  $90^\circ$ . 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  $c$  as the flap is moved from its closed to its open position. The opening torque characteristic thus rises with the opening angle  $\alpha$ , 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.

GB-A-1,423,832 discloses a telescopic stay comprising two springs adapted to telescope one at least partially into the other, the inner spring being weaker than the outer spring.

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 extendable strut the effective radius of action of which increases as the flap is moved from its closed to its fully open position, an example of which is disclosed in EP-A-0,314,201.

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 mechanism 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 21 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 pivots 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.

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  $\alpha_1$  in Fig. 4 and then the lower pressure spring of the pair outstrokes to move the flap 13 from its  $\alpha_1$  position to its  $\alpha_2$  position as 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  $\alpha$  is the opening angle of the flap 13. This tor-

que 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  $15^\circ$  to the horizontal when closed and  $55^\circ$  to the horizontal when open, i.e.  $\alpha_2 = 55^\circ$ . For the more general case with a flap 13 required to open from  $0^\circ$  to  $90^\circ$  the curve g in Fig. 4 would commence as shown in Fig. 3 and drop down vertically at the  $\alpha_1$  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 (40,42) the effective radius of action of which increases as the flap (13) is moved from its closed to its fully open position, characterised in that the strut is composed of a series of springs (40) of different linear spring rates.
2. A ventilator as claimed in claim 1 in which the springs are gas springs (40), the pressure of gas in one of which, when fully outstroked, is higher than the pressure of gas in another of the springs (40) when fully instroked.
3. A ventilator as claimed in claim 2 in which the springs (40) are fixed in parallel, side-by-side.
4. A ventilator as claimed in claim 2 in which the

springs (40) comprise a pair of telescoping gas springs, one housed within the other.

l'intérieur de l'autre.

## Patentansprüche

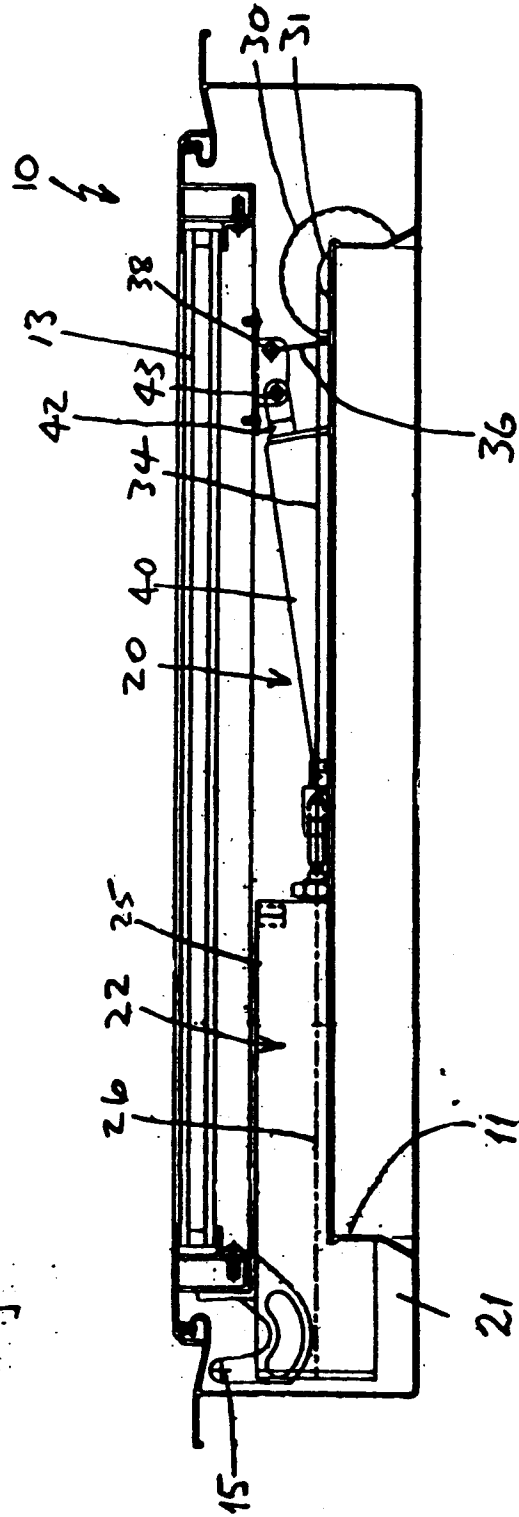
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1. Ein durch Federn öffnender schwenkbarer Ventilator mit gelenkiger Klappe, der eine Öffnungsfeder in der Form eines linear ausdehnbaren Stempels (Strut) (40,42) aufweist, dessen effektiver Aktionsradius sich vergrößert, wenn die Klappe (13) von ihrer geschlossenen in ihre vollständig offene Position bewegt wird, dadurch gekennzeichnet, daß der Stempel aus einer Reihe von Federn (40) mit verschiedenen linearen Federkonstanten zusammengesetzt ist. 10 15
2. Ein Ventilator gemäß Anspruch 1, in dem die Federn Gasfedern (40) sind, wobei der Gasdruck in einer dieser, wenn vollständig ausgezogen, größer ist als der Gasdruck in einer anderen der Federn (40) , wenn vollständig eingezogen. 20
3. Ein Ventilator gemäß Anspruch 2, in welchem die Federn (40) parallel, Seite an Seite angeordnet sind. 25
4. Ein Ventilator gemäß Anspruch 2, in welchem die Federn (40) ein Paar Teleskopgasfedern umfassen, wobei eine in der anderen untergebracht ist. 30

## Revendications

1. Ventilateur avec volet muni d'un ressort pour l'ouvrir, comprenant un ressort d'ouverture sous forme d'un étau (40, 42) linéairement extensible dont le rayon d'action effectif augmente quand le volet (13) est déplacé de sa position fermée vers sa position complètement ouverte, caractérisé en ce que l'étau est composé d'une série de ressorts (40) de différentes flexibilités de ressort linéaires. 35 40
2. Ventilateur selon la revendication 1, dans lequel les ressorts sont des ressorts à gaz (40), la pression de gaz de l'un, quand il est totalement sorti, est plus élevée que la pression de gaz dans l'autre des ressorts (40), quand il est complètement rétracté. 45 50
3. Ventilateur selon la revendication 2, dans lequel les ressorts (40) sont fixés parallèlement l'un à l'autre, l'un à côté de l'autre. 55
4. Ventilateur selon la revendication 2, dans lequel les ressorts (40) sont formés par une paire de ressorts à gaz télescopiques dont l'un est logé à

Fig 1



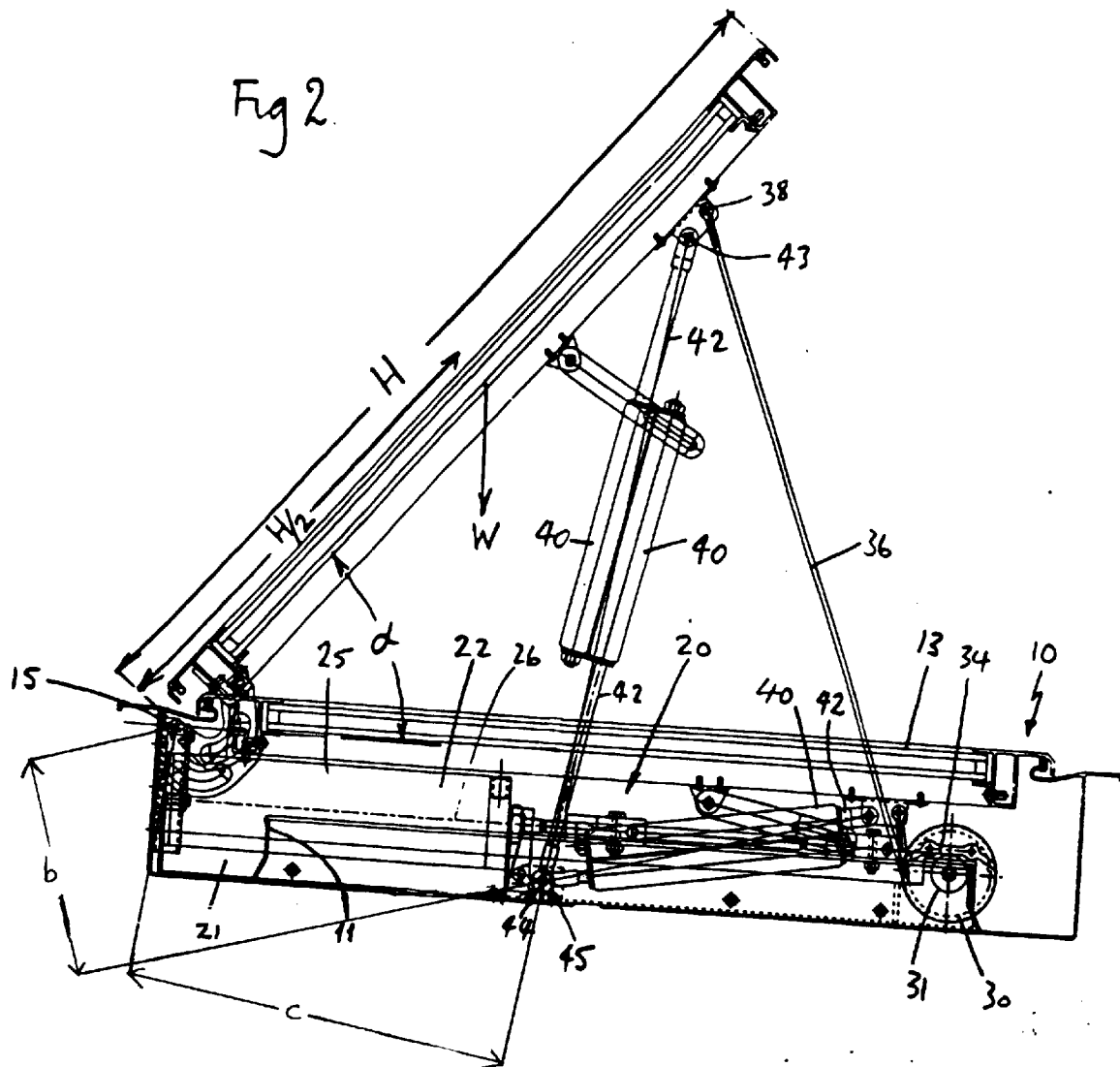
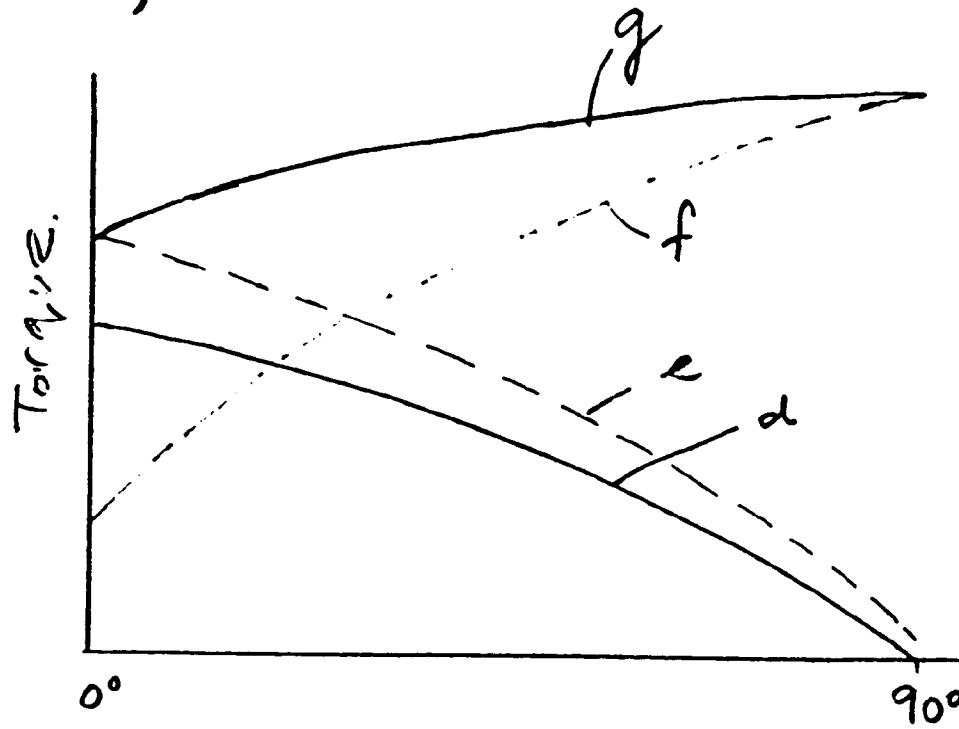
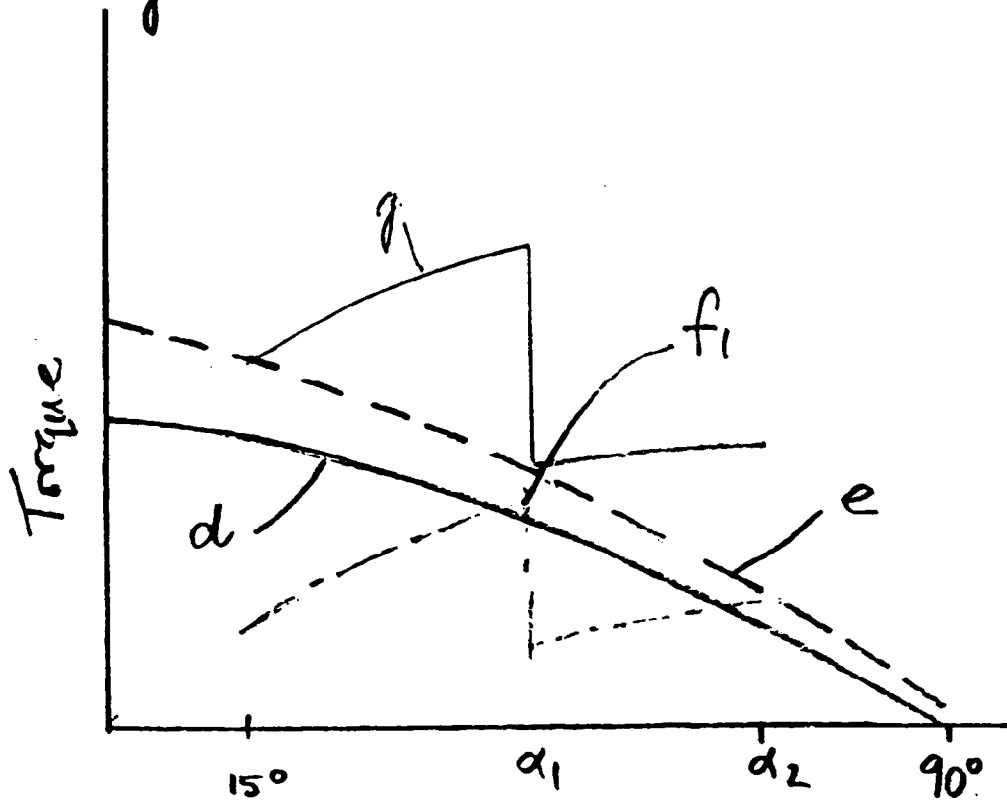


Fig 3



opening angle of flap.

Fig 4



opening angle of flap.