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(54) IMPROVEMENTS IN OR RELATING TO FLOW REGULATORS FOR VENTILATORS, FANS OR THE LIKE

(71) We, WILHELM GEBHARDT GmbH, a German Company organised under the laws of the Federal Republic of Germany of 7112 Waldenburg, Germany,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a flow regulator for ventilators, fans, or the like.

Flow regulators of the type which comprise a gear for the simultaneous adjustment of guide blades pivoted at one end on an inner wall of a casing, and at the other end on a hub or the like, have been used in particular for the infinitely variable control of the ventilator output and for the adjustment of the fluctuating requirements of flow-volume and pressure. These regulators are mainly used where throttle regulation brings about undesirable losses and speed governors are considered to be too expensive.

According to one aspect of the present invention there is provided a flow regulator for a ventilator, fan, or the like, said regulator comprising guide blade members and a gear assembly for adjustment thereof, each of the guide blade members being arranged to be pivotally mounted at one end on a gear housing, the latter being arranged to be fixed relative to the ventilator, fan, or the like, and pivotally mounted at its other end on a wall of an intake casing of the ventilator, fan, or the like, the gear assembly comprising a ring member which is co-axial with, and rotatably located within the gear housing, to be movable over a relatively large guide surface area thereof, the ring member being circumferentially provided with equidistantly spaced, axially parallel slots, the latter each being open at one end and defining guide faces for arcuate end sections of respective adjustment levers, and opposite end sections of the adjustment levers being fixed to inner pivots of the respective guide blade members which extend substantially in the radial direction, whereby the guide blade members may be simultaneously adjustable.

According to a further aspect of the present invention there is provided a regulator as described in the preceding paragraph mounted in a stationary intake nozzle of the ventilator, fan or the like, the regulator being adapted to fit therein.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:-

Figure 1 is an axial end view of an intake port of a flow regulator according to the invention;

Figure 2 is a longitudinal section along II-II in Figure 1, showing part of the regulator, a blade of an impeller being indicated by chain-dotted lines;

Figure 3 is an axial section through the regulator, displaced by 90° relative to Figure 2, showing the region of the adjustment gear, the extreme positions of the guide blades respectively being indicated again by chain-dotted lines; and

Figure 4 is a section along IV-IV in Figure 3.

Referring to Figures 1 and 2, a flow regulator 11 for inflow in the direction of arrow A, is built into a fixed intake nozzle 12 of a ventilator or fan of which only one of the blades 13 of the radial flow impeller is indicated in chain-dotted lines, in Figure 2.

Adjusting gear 14 for controlling the positions of guide blades 16 of the regulator is centrally located in the region of a drive shaft 17 of the ventilator or fan and directly surrounds the shaft 17. The dimensions of the ventilator or fan are therefore unaffected by the intallation of the regulator 11. Although only one of the guide blades

13 of the radial flow impeller is presented to illustrate systems with ventilators or fans which have only one suction side, this does not restrict the applicability of the flow regulator 11 to one-sided systems but it is understood that the regulator 11 may also be built into ventilators or the like which operate on the basis of double-sided action. In these cases, however, a regulator 11 would have to be built into both of the two intake nozzles. It is moreover understood that the regulator 11 could be built on to an existing ventilator, fan, or the like that is to say, it could be located in front of the intake nozzle 12 if this is considered advisable, although the flow regulator 11 has been designed especially for incorporation into the adjusting-gear 14.

The intake nozzle 12 is defined by a casing 18 which tapers substantially conically towards the ventilator impeller and is provided with radial supporting arms 19 which are fixed to a flange-like intake side, the inner end sections of said arms being connected to the casing of a hub bearing 21 for a drive shaft 17 of the ventilator, fan, or the like. Guide blades 16 of the regulator 11, of radially outwardly increasing width, are equidistantly spaced around the circumference, where they are pivoted on the nozzle casing 18 by means of pins 22 in plastics bushings which support their outer blade ends or rather their wider end sections. The inner blade ends, i.e. the narrow end sections, are pivoted on pins 23 on a housing or casing 24 of the adjusting gear 14. Each inner pivot 23 extends through a bore 26 in the gear casing 24, into a substantially hollow, cylindrical interior of the casing 24, each pivot 23 being fixed at its radially inner end to an adjusting lever 27. In the chosen embodiment the rotational axis 28, that is to say, the connecting line between the pivots 22 and 23, of the guide blades 16 extends accurately radially, and the pivot 23 therefore extends at right angles to the lever 27.

The free end sections of the adjusting levers 27 are provided with ball-heads 29, each of which engages in a slot 31 in an adjusting ring 32 which is coaxially accommodated in the gear casing 24 and rotatably supported relative to the latter. The slots 31, the number of which corresponds to the number of the adjustable blades 16, or rather the levers 27, are equidistantly arranged around the circumference of the ring 32; they extend in the radial direction, and are open towards the end face of the ring 32 which is adjacent to the levers 27. The slots 31 whose bottom ends correspond to the spherical form of the ball heads 29 are approximately as wide as the diameter of the ball heads 29 but they are considerably longer, preferably twice as long as they are wide. The heads 29 of the levers 27 are essentially supported without play in the slots 31 or rather between their lateral limiting walls which constitute guide faces 34.

The end section of the ring 32 which is remote from the slots 31 is provided with a radial bore 36 at its circumference, to accommodate a lever 37 of a drive linkage 38. The lever 37 extends through an elongate circumferentially extending slot 39 in the gear casing 24, so that this lever in its starting or neutral position according to Figure 1, may rotate together with the set-ring 32, around the drive shaft 17.

At the end of the hollow-cylindrical casing 24 which is remote from the radial bores 26 for the pivot pins 23, is an annular recess 41 into which the ring 32 is rotatably fitted, the two end faces of the ring 32 and casing 24, when assembled, aligning with each other. In the chosen embodiment, the internal diameter of the ring 32 exceeds the external diameter of the drive shaft 17; the regulator 11 can therefore be built without difficulty into ventilators having a heavier drive shaft 17. The end section of the gear casing 24 which is provided with the annular recess 41 or the elongated slot 39 respectively, is connected to a retaining plate 42 whose bent lugs or arms 43, provided with slots 44, embrace the supporting arms 19 of the intake nozzle 12, constituting with them a firm connection where the arms 19 are joined to the bearing 21. The end section of the gear casing 24 which is remote from the retaining plate 42, is covered by a disc 46 let into the front wall of the casing. Depending on the diameter of the drive shaft 17, this disc may be interchanged with discs having a wider or smaller central bore 47.

With the orientation of the adjusting levers 27 and the drive lever 37, it is possible to make optimum use of the available space and ensure, on the other hand, that the additional bending load induced into the parts of the adjustment gear is very low. The large guide faces along which the adjusting ring may slide in the supporting casing, reduce the surface pressure and wear to a minimum.

The guide blades 16 are not profiled. They may consist of galvanised steel sheeting. Their axis of rotation 28 extends radially, and their longitudinal median axis 48 is displaced, by one to two degrees, relative to the axis of rotation. The direction of displacement is such that the resulting wider blade section, seen from the axis of rotation 28, extends towards the radial flow impeller of the ventilator, fan, or the like. It is attributable to this slight relative displacement of the two axes 28 and 48 that the pressures applied to the blade surfaces by the forces of adjustment may be smaller by some 50% compared with symmetrical blade supporting systems. The number of guide blades 16 of the flow regulator 11 depends on the length of the circumference of the nozzle 12, and it is preferably between 5 and 20 blades.

The drive linkage 38 extends beyond the compass of the regulator 11, and may be adjusted by hand or by means of a motor. When the ventilator operates on the basis of double sided suction, where each intake nozzle 12 is provided with an individual regulator 11, the adjusting gears 14 of the two regulators may be interconnected with the aid of an additional linkage so that they may be adjusted uniformly in a contrarotatory, or any other suitable manner.

As shown especially in Figures 3 and 4, the lever 37 of the drive linkage 38 is rotatable around the drive shaft 17 as indicated by the arrow D, to cause the ring 32 to turn around the same angle relative to the stationary gear casing 24. The ball heads 29 of the adjusting levers 27, which are located between the two guide faces 34 of the slots 31 in the adjusting ring 32, are forced to move in the circumferential direction; this causes the pivots 23 to revolve and consequently forces the guide blades 16 to rotate around their axes of rotation 28. During this rotary movement, however, the heads 29 also move in the radial direction inside the slots 31, as is indicated by the double-headed arrow B. The transmission between the adjusting ring 32 and the guide blades 16 is such that the latter may rotate through an angle of $\alpha = 92°$ between their closed position and their fully opened end position, and assume any desired opening angle in an infinitely variable manner of regulation (See Figure 3). The force which must be available for the adjustment of the ring 32 is very small because of the small rotational angle. All blades 16 are controlled simultaneously and uniformly.

Since the centrally located, compact adjusting gear 14 as such remains unaffected by the installation of the regulator 11, the latter may be assembled with various ventilators or the like. The only adjustment which may have to be made in order to match the different nozzle diameters is that blades of different length may have to be fitted into the inner pivot members. Since both the blades 16 and the gear 14 are inside the edge of the nozzle 12 it is evident that the installation of a flow direction regulator 11 does not interfere with the installation dimensions of the ventilator or fan. The mounting of the gear 14 on the nozzle bearing is very simple, and it guarantees especially that the flow resistance is not increased, the gear casing being located behind the bearing, and having a smaller diameter.

A flow regulator as hereinbefore described does not project beyond the edges of the associated ventilator or fan. It is an additional advantage that the gear as such may be used with a number of regulators independently of the required blade length. This adjustment gear is moreover considerably less expensive and its dimensions may be considerably smaller than those of known adjustment gears, and its weight may therefore be small enough to make the gear ideally suitable for light weight ventilators. Finally, the adjusting forces are moderate.

The arrangement is feasible because the diameter of the regulator does not exceed the external diameter of the guide blades. It is therefore possible to combine a flow regulator with a ventilator, fan or the like without making any demands on additional installation space. Bearing in mind that the intake nozzle is present in any case, there is therefore no need for a modification of the main dimensions of the ventilator or fan. This means that the regulator may be built in at any time, as a supplementary unit. This is an advantage especially for ventilators drawing in from either side, because no adjustment or displacement is required of belts or similar drive elements when installing the flow regulator which, in these cases, constitutes an indispensible structural element, accommodated in the vicinity of the intake- i.e. suction port. Ventilators having suction parts at either side should be equipped with a set of two adjusting gears which are interconnected through a lever. When building a regulator into the nozzle of a ventilator fan, or the like, it is recommended to connect the gear casing with the ventilator- or fan-bearing. Since the gear diameter may be equal to or smaller than the ventilator- or fan bearing, and since it may be located behind the latter, as viewed in the direction of suction, it is evident that the flow losses created as a result of installing an adjusting gear into the suction port, remain negligibly small.

Summarising, a regulator design has been provided which, with a given air throughput (the adjustment being related to its volume), reveals possibilities for optimum utilisation of the available installation space and yields the most favourable strength values.

Various modifications may be made without departing from the invention, as defined by the appended claims. For example, the free end sections of the levers 27 may have a cylindrical shape.

WHAT WE CLAIM IS:-

1. A flow regulator for a ventilator, fan, or the like, said regulator comprising guide blade members and a gear assembly for adjustment thereof, each of the guide blade members being arranged to be pivotally mounted at one end on a gear housing, the

latter being arranged to be fixed relative to the ventilator, fan, or the like, and pivotally mounted at its other end on a wall of an intake casing of the ventilator, fan, or the like, the gear assembly comprising a ring member which is co-axial with, and rotatably located within the gear housing, to be movable over a relatively large guide surface area thereof, the ring member being circumferentially provided with equidistantly spaced, axially parallel slots, the latter each being open at one end and defining guide faces for arcuate end sections of respective adjustment levers, and opposite end sections of the adjustment levers being fixed to inner pivots of the respective guide blade members which extend substantially in the radial direction, whereby the guide blade members may be simultaneously adjustable.

2. A regulator according to claim 1, wherein the width of the slots is substantially equal to the width of the arcuate end sections of the adjusting levers, the slot length being considerably greater.

3. A regulator according to claims 1 or 2, wherein an end section of the ring member which is remote from the slots is provided with a radial bore and the gear housing comprises a circumferentially extending slot which communicates with the radial bore, an operating lever extending through the slot into the radial bore and being connected with a linkage suitable for manual or powered adjustments.

4. A regulator according to any of the preceding claims, wherein the ring member is fitted into an annular recess in the gear housing, an open end of the latter being covered by a disc.

5. A regulator according to any of the preceding claims, wherein the rotational axis and the median axis of each of the guide blade members are displaced relative to each other by approximately one to two degrees.

6. A regulator according to claim 5, wherein, in use, the wider section of the blade surface divided by the rotational axis is adjacent to the impeller of the ventilator, fan or the like.

7. A regulator according to any of the preceding claims, mounted in a stationary intake nozzle of a ventilator, fan or the like, the regulator being adapted to fit therein.

8. An arrangement according to claim 7, wherein the regulator is integrated into the design of the intake nozzle, a drive shaft of the ventilator, fan or the like extending through the regulator.

9. An arrangement according to claim 7 or 8, wherein the gear assembly is located behind a hub bearing of the intake nozzle as viewed in the direction of inflow.

10. An arrangement according to claim 9, wherein the gear housing has an outer diameter smaller than, or equal to, the outer diameter of the hub bearing.

11. An arrangement according to claim 9 or 10, wherein the gear housing is fixed to the hub bearing by means of a plate with bent lugs, the latter embracing the hub bearing in the region of radial arms which support the intake nozzle.

12. An arrangement according to any of claims 7 to 11, wherein each of the intake nozzles of ventilators in double-sided suction systems has its own regulator, the two gear assemblies being interconnected by means of a lever system.

13. A flow regulator for a ventilator, fan or the like, substantially as hereinbefore described with reference to the accompanying drawings.

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1584086 COMPLETE SPECIFICATION

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Sheet 1

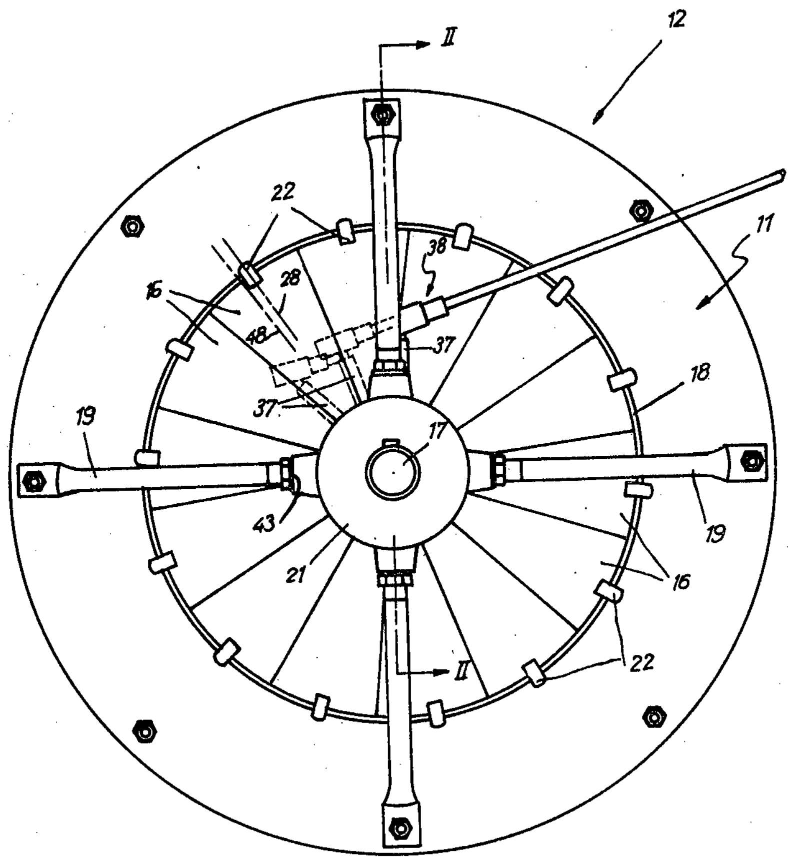

Fig. 1

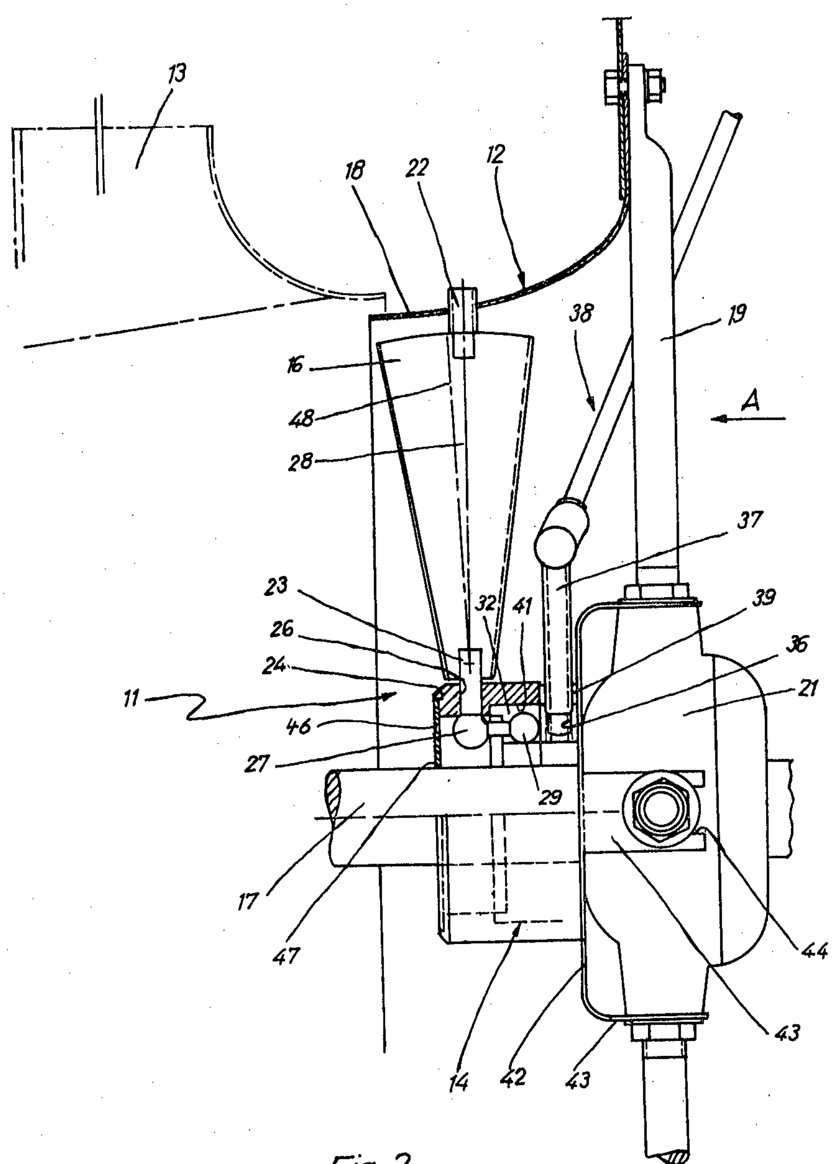
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Fig. 2

1584086 COMPLETE SPECIFICATION

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Sheet 3

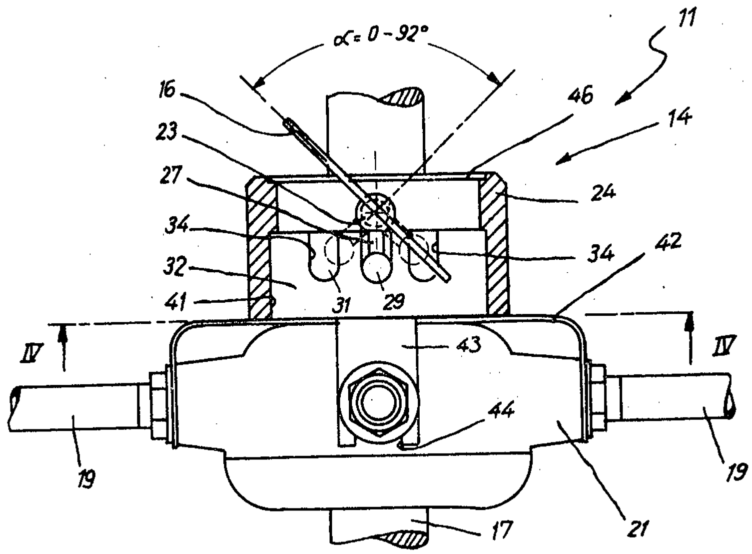

Fig. 3

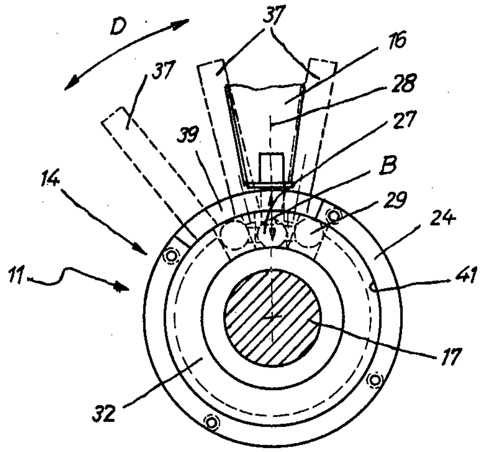

Fig. 4