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R. V. WOODBURY

2,793,804

FANS WITH SPIN VANES

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Fig. 1.

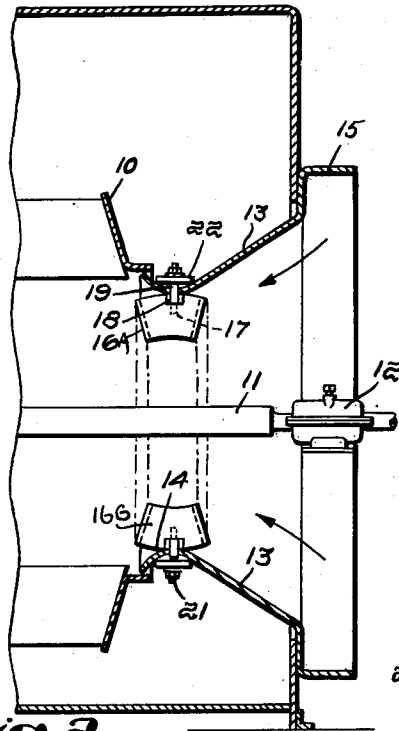


Fig. 2.

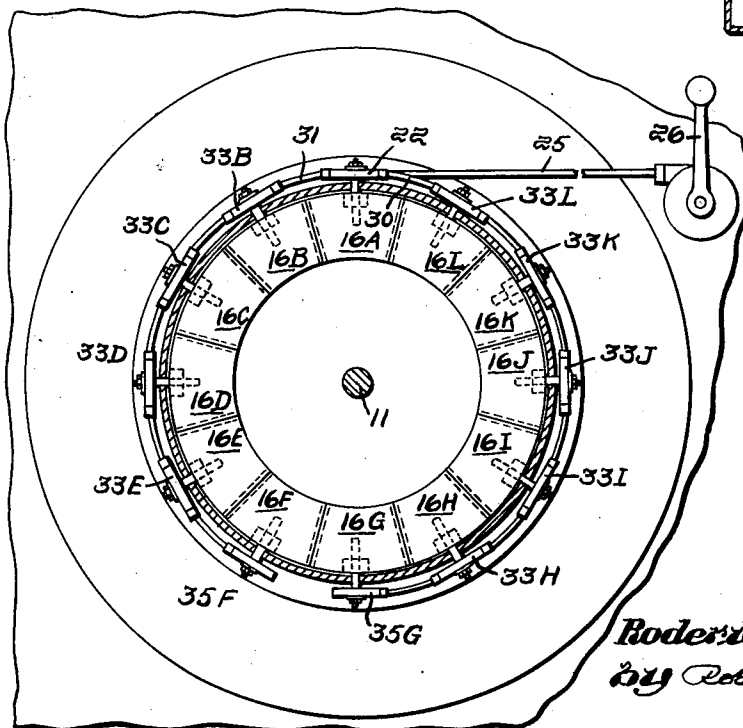


Fig. 3.

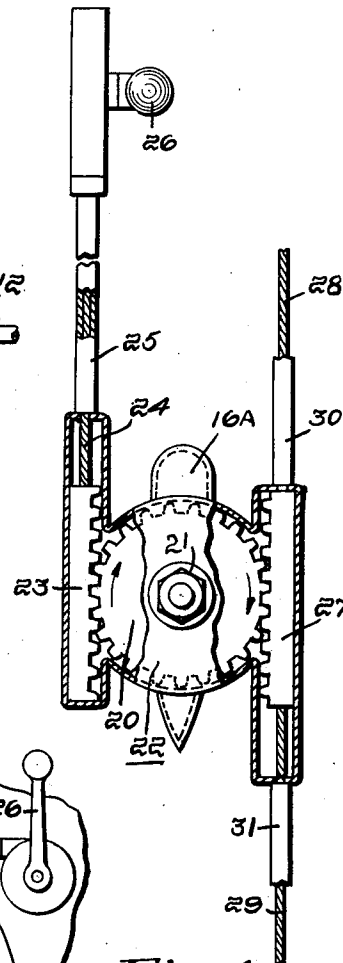
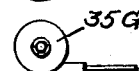


Fig. 4.



Fig. 5.



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2,793,804

FANS WITH SPIN VANES

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1 Claim. (Cl. 230—114)

This invention relates to fans used for moving air or other gases, and relates more particularly to spin vanes for varying the volume of gas moved by such fans.

Adjustable spin vanes are widely used for varying the volume of air or other gases moved by fans. Their advantages and methods of operation are fully disclosed in the U. S. Patents Nos. 1,846,863 and 1,989,413 of H. F. Hagen. Heretofore, such spin vanes have extended completely across the fan inlets; have been rotatably supported at their outer ends in the inlet sheet of a fan housing, and have been rotatably supported at their inner ends in a support extending around the fan shaft. Such vanes have been rotated by gearing and linkage as disclosed in said Hagen patents, or by gearing within an annular support around the fan shaft as disclosed in the U. S. patents of E. L. Richardson, No. 2,100,489 and A. C. Bartlett-M. S. Leonard, No. 2,113,391.

In a fan equipped with such adjustable spin vanes, the inner portions of the vanes and their supports extend into the gas stream and cause turbulence and resistance to gas flow even with the vanes in wide-open position.

For many duties, the volume of gas handled by a fan need not be reduced to less than 50% of maximum. I have found that for such duties, the spin vanes need not extend completely across the fan inlet so as to require support at their inner ends, but can be so shortened that they extend but a fraction of the distance from the inlet sheet towards the fan shaft, and can be supported at their outer ends only.

In one embodiment of this invention, the pivot rods of the vanes extend through the inlet sheet, and have, on the outer side of the inlet sheet, spur gears attached thereto which are rotated for adjusting the vanes, by gear racks which are interconnected by a flexible shaft slidable within a guide therefor.

An object of this invention is to simplify adjustable spin vanes for fans.

Another object of this invention is to reduce the resistance to gas flow of spin vanes and their supports.

Another object of this invention is to reduce the manufacturing cost of spin vanes for fans.

This invention will now be described with reference to the annexed drawings, of which:

Fig. 1 is a fractional side section of a centrifugal fan embodying this invention;

Fig. 2 is an end section of the fan with the spin vanes in closed position;

Fig. 3 is an enlarged detail view, partially in section, of one of the gear boxes used for rotating the vanes;

Fig. 4 is a plan view of one of the gear boxes intermediate the gear box shown by Fig. 3 and the end gear boxes, and

Fig. 5 is a plan view of one of the end gear boxes.

The centrifugal fan illustrated by the drawings, has a fan wheel 10 attached to a rotary shaft 11 which is supported by end bearings 12, only one of which is shown. The fan has an inlet sheet 13 which is shaped substantially as a frustrum of a cone except that it has a curved

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inner portion 14 adjacent the fan wheel, and has an outwardly turned cylindrical portion 15 to which the illustrated bearing 12 is attached.

The twelve spin vanes 16A—16L are attached at their outer portions to the inner portions of the radially extending pivot rods 17, the outer portions of which extend through the sleeves 18 and the bushings 19, the latter being contained in circular openings in the curved inlet sheet portions 14. The threaded upper ends of the pivot rods have the spur gears 20 attached thereto. The gears 20 are contained within gear boxes which also contain gear racks meshed with the gear 20. There are three types of generally similar gear boxes used. One type is the gear box 22 illustrated by Fig. 3, and used with the top center vane 16A. The gear box 22 contains a gear rack 23 meshed with the gear 20 therein, and connected to one end of the flexible shaft 24 which is slidably supported within the guide 25, and which is connected at its other end to the rotary control arm 26. Another gear rack 27 is meshed with the gear 20 opposite to where it is meshed with the rack 23. The rack 27 has the flexible shafts 28 connected to its ends, and which extend slidably within the guides 30.

The gear boxes 33B—33E and 33H—33L are of the second type, and are used with the vanes 16B—16E and 16H—16L respectively. They are similar to the gear box 22 of Fig. 3 except that they do not include gear racks corresponding to the rack 23. They do, however, have gear racks similar to the rack 27 of Fig. 3, which gear racks are connected by flexible shafts extending through the guides 34 which are similar to the guide 30.

The third type of gear box includes the end gear boxes 35F and 35G which are similar to the gear boxes 33B—33E and 33H—33L except that the gear racks therein are connected to flexible shafts at one end only.

Movement of the control arm 26 causes the flexible shaft 14 to move the rack 23 causing the gear 20 to rotate and to rotate the spin vane 16A to which it is attached. Depending upon the direction of rotation of the arm 26, the spin vane 16A is rotated towards open or closed position. Rotation of the gear 20 also causes movement of the rack 27 causing the flexible shafts 28 to move and to move the racks within the adjacent gear boxes 33B and 33L. Movement of the latter racks causes the spin vanes 16B and 16L to rotate and causes the flexible shafts within the guides 34 to move the racks within the gear boxes 33C and 33K. This causes the spin vanes 16C and 16K to rotate, and causes the flexible shafts connected to the latter racks to move the racks within the gear boxes 33D and 33J. This causes the spin vanes 16D and 16J to rotate, and causes the flexible shafts connected to the racks within the gear boxes 33D and 33J to move the racks within the gear boxes 33E and 33I. This causes the spin vanes 16E and 16I to rotate, and causes the flexible shafts connected to the racks within the gear boxes 33E and 33I to move the racks within the gear boxes 33H and 35F. This causes the spin vanes 16H and 16F to rotate, and causes the flexible shaft connected to the rack within the gear box 33H to move the rack within the gear box 35G, and causing the spin vane 16G to rotate.

The gear box 22 is seen to drive all of the other gear boxes and to be located about midway between the end gear boxes 35F and 35G. In this position, about half of the driving load is handled in each direction. The flexible shaft motion on each side of the gear box 22 is about one-half what it would be if the gear box 22 drove all of the gear boxes in the same direction from only one of its sides. This aids in the relative response of the vanes by reducing lost motion. Also, more uniform force distribution and smoother operation of the vanes result.

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The inner ends of the vanes in the illustrated embodiment, terminate about one-third of the distance from the inlet sheet portion 14 to the shaft 11. While the vanes are relatively short as compared to prior vanes, they act at the greatest radii around the inlet, and thus are located in the area most effective for the production of spin in the direction of wheel rotation.

The inner ends of the vanes 16 are curved so that in closed position as shown by Fig. 2, they form, together with the shaft 11, an annulus. Preferably, the vanes have airfoil sections as shown by Fig. 3 for reducing drag.

While one embodiment of the invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangements of apparatus illustrated, since modifications thereof may be suggested by those skilled in the art, without departure from the essence of the invention.

What is claimed is:

In combination with a fan having a rotary shaft, a bladed rotor on said shaft, an inlet sheet around the entrance to said rotor, and spin vanes having pivot rods at their outer ends supported from and journaled in said sheet, means for rotating said pivot rods, said means comprising a gear on one of said rods, a front rack meshed

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with said gear on one side thereof, a vane rotating control connected to said rack, a second rack meshed with said gear on the other side thereof, gears on the others of said rods, racks meshed with said last mentioned gears, a flexible shaft connected to one end of said second rack and to one end of one of the next adjacent of said last mentioned racks, a second flexible shaft connected to the other end of said second rack and to one end of the other next adjacent rack of said racks meshed with said last mentioned gears, and flexible shafts connecting the other end of said one adjacent rack to some of the remaining racks meshed with said last mentioned gears and connecting the other end of said other adjacent rack to the others of said remaining racks.

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