

Aug. 19, 1941.

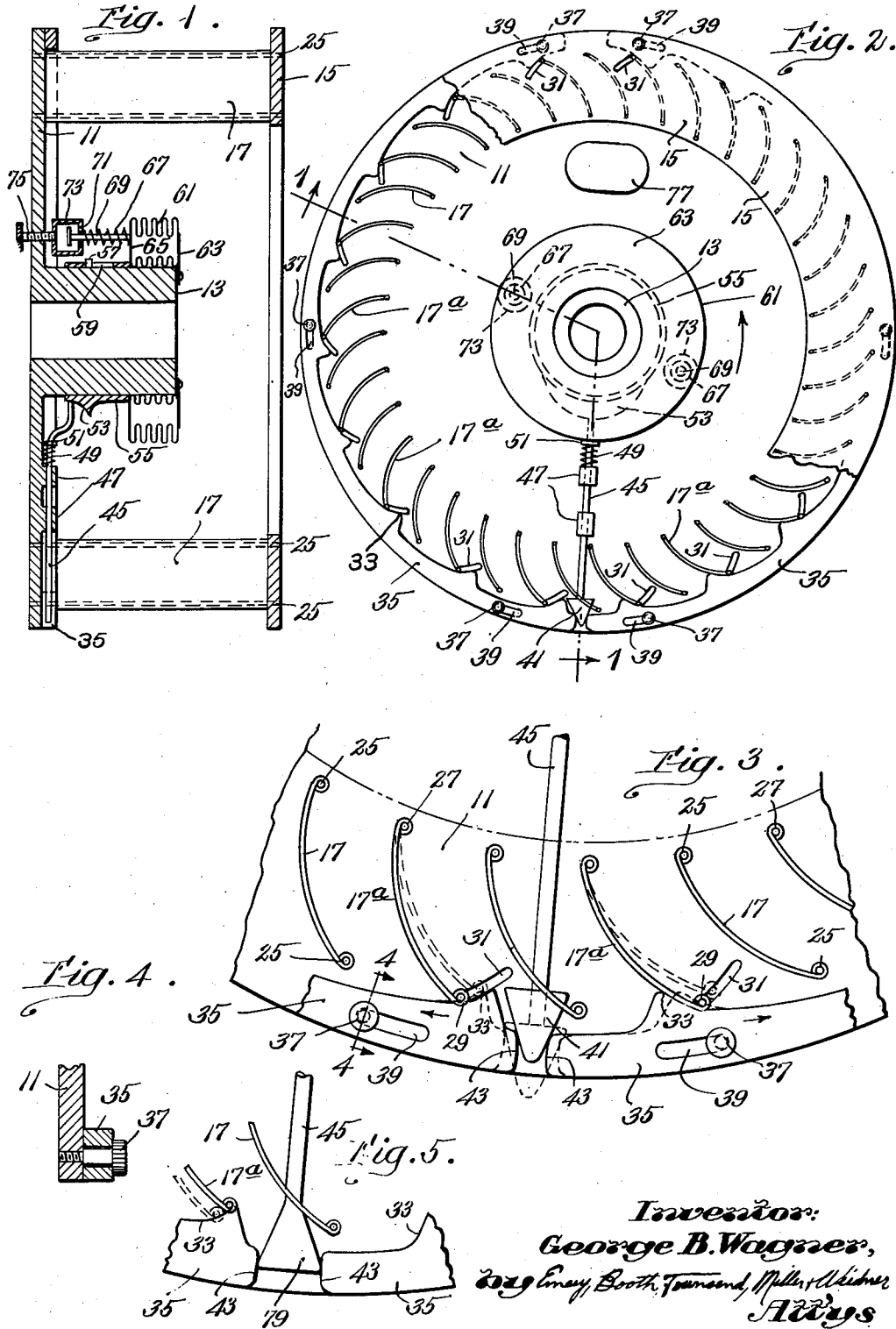
G. B. WAGNER

2,253,406

AIR DELIVERY DEVICE

Filed May 31, 1938

2 Sheets-Sheet 1



Inventor:
George B. Wagner,
 by Emory Booth, Townsend, Miller & Lechner,
 Attys

Aug. 19, 1941.

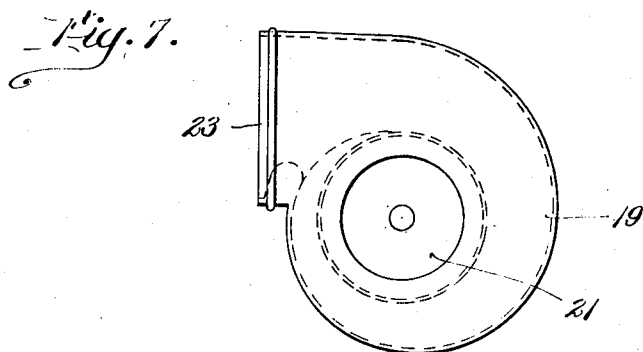
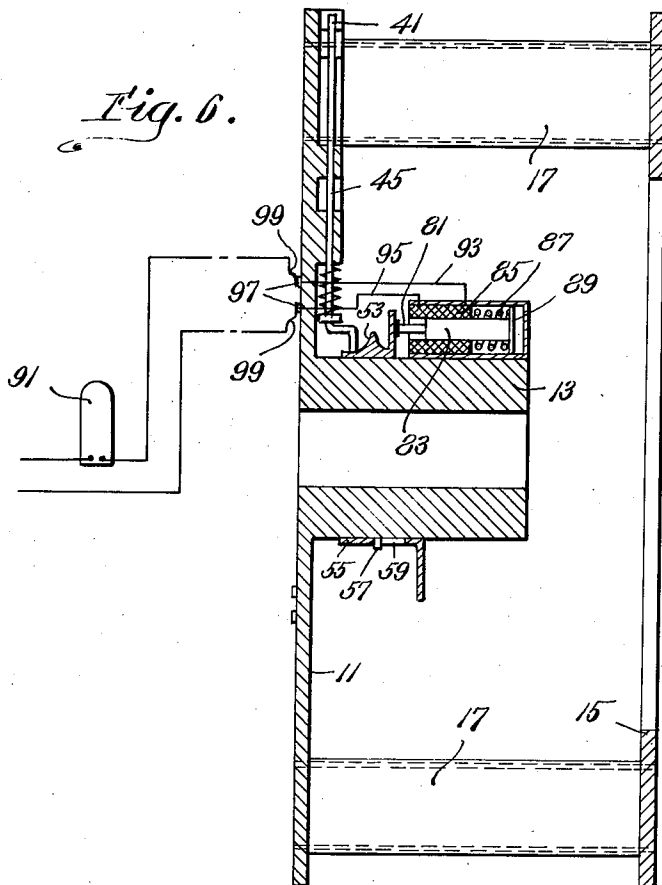
G. B. WAGNER

2,253,406

AIR DELIVERY DEVICE

Filed May 31, 1938

2 Sheets-Sheet 2



Inventor:
George B. Wagner,
By Emory Booth, Foreman, Miller & Heidner
Attys.

UNITED STATES PATENT OFFICE

2,253,406

AIR DELIVERY DEVICE

George B. Wagner, Holbrook, Mass., assignor to
Albert W. Rockwood, Wakefield, Mass.

Application May 31, 1938, Serial No. 210,828

3 Claims. (Cl. 230—114)

This invention relates to air delivery devices, such as mechanically driven air pumps, blowers, fans and the like, and particularly those employed in supplying or removing air for ventilation, air conditioning, refrigeration and other purposes.

One object of the invention is to provide a power driven air delivery device, the air delivery capacity of the impelling element or elements of which may be varied without the necessity of relying on a change in driven speed.

Another object of the invention is to provide such an air delivery device as will automatically adjust itself in respect to its air delivery capacity to meet the requirements in the space or area to be conditioned, as by responding to prevailing temperature conditions in the air, either that supplied to or removed from the conditioned space.

In the air conditioning of a given space, for example, where it is desirable to maintain the inside temperature at a certain stage, it may become necessary, dependent on the conditions in any case, to so control the air delivery as both to supply and remove either decreasing or increasing amounts of air when the inside temperature rises, and on the other hand to supply greater or lesser amounts of air, as the case may be, when the temperature lowers.

These objects have heretofore been sought either by varying the speed of the air delivery device, as by the use of variable speed motors, or by throttling the air delivered through the employment of dampers or the like.

A speed change in the air delivery device, however, is undesirable from the standpoint of engineering efficiency, the use of variable speed motors involves substantial added expense, and, in the case of motors operating on alternating current, speed changes take place over such wide gaps that the proper conditions cannot often be met.

The employment of dampers is also unsatisfactory not only because of the less efficient conditions under which the air propulsion device is operated, and because of the noise with which the use of such dampers is apt to be attended, but because in many instances the designed and intended characteristics of the air volumes being dealt with are altered and the balanced condition aimed at is upset.

These and other objects of the invention will be best understood by reference to the following description when taken in connection with the

accompanying illustration of one specific embodiment thereof, while its scope will be more fully pointed out in the appended claims.

In the drawings:

5 Figure 1 is an axial sectional elevation of an air impeller of the squirrel cage type, taken on the line 1—1 in Fig. 2 and embodying one form of the invention;

10 Fig. 2 is a side elevation of the air impeller shown in Fig. 1, illustrating the position and mounting of the impeller blades;

15 Fig. 3 is a similar but fragmentary side elevation on a larger scale of a portion of the same impeller, illustrating the adjustable blades and the blade adjusting means;

20 Fig. 4 is a sectional detail, on the line 4—4 in Fig. 3, showing the mounting of one of the blade adjusting shoes;

25 Fig. 5 is a fragmentary view, showing a modified form of the blade adjusting member;

30 Fig. 6 is a central, sectional elevation similar to Fig. 1, illustrating a further modification of the invention; and

35 Fig. 7 shows a conventional form of housing for use with an impeller of the type illustrated in the preceding views.

Referring to the drawings and to the embodiment of the invention submitted for illustrative purposes, and to the impeller shown in Figs. 1 to 4, the air delivery device is there shown as comprising a power-driven, rotary, impelling member of the squirrel cage type, consisting of the plate 11 provided with a hub 13 adapted to be fixed on a driving shaft (not shown), the plate facing an axially opposed, annular ring 15 of an outside diameter equal to that of the plate, the latter and the ring serving as opposite, spaced supports for a series of transverse air impelling blades 17 which are arranged peripherally around the resulting squirrel cage like structure.

45 The impeller is adapted to be mounted in a casing 19 of the type shown in Fig. 7, with the annular ring 15 facing an air admission opening 21 in the side walls of the casing, so that, as the impeller is rotated, air is drawn into the casing and into the interior of the impeller and forced by the centrifugal action of the blades outwardly and through the discharge conduit at 23.

50 The blades are so arranged that one or more or all of them, but herein, for illustration, each alternate blade, may be adjustable, while the device is being operated, through the effect of

changing air conditions to vary the relation of the blade to the air impinged thereon, and in such manner as to increase or decrease the volume of air delivered by the impeller.

The blades herein comprise the fixed blades 17 and the adjustable blades designated as 17a. Each fixed blade is formed of sheet metal, with each opposite end bent and wrapped tightly over a pin 25, the opposite protruding ends of each of which are fixed, one in the ring 15 and the other in the plate 11, to give the blade a fixed position, the blades being inclined outwardly and slightly concaved toward the direction of rotation, which is indicated by the arrow in Fig. 2.

Each alternate movable blade 17a is similarly shaped. The inner edge of each blade 17a is bent and wrapped tightly about a pin 27, the protruding ends of which have a pivotal support, one in the ring and the other in the plate, so that the blade is capable of swinging about such pivotal support. The opposite end of each blade is similarly wrapped about and fastened to a pin 29, the protruding ends of which extend each into an inclined slot 31, there being similar and opposite slots in both the ring and the plate to receive and guide each protruding pin.

To adjust the position of the movable blades 17a, their outer curved tips rest against and are engaged each by a cam surface 33 presented by a sliding arc-shaped shoe 35. Two such semi-annular shoes are provided, arranged diametrically on opposite sides of the impeller, each shoe being mounted for sliding movement on the inside peripheral face of the plate 11, being held thereon by a series of studs 37 (Fig. 4) which pass each through an arc-shaped slot 39 in the shoe, so that each shoe is capable of a limited circumferential movement.

When the impeller is being driven for the delivery of air in the direction of the arrow, the movable blades are forced by the reaction of the air into a position where their outer tips or edges rest against the cam surfaces 33. When the impeller is to be operated at full volume capacity, the shoes 35 are positioned so that the movable blades occupy each a position parallel to that of the fixed blades 17, which represents the most effective air delivery position. The shoes 35, however, may be simultaneously moved circumferentially, one in the direction of rotation and the other in the opposite direction, by means to be described, so that each blade is thereupon adjusted about its peripheral support to assume a position more or less inclined to the position of the fixed blades (such as that indicated by dotted lines in Fig. 3), dependent on the extent of movement of the shoes, thereby having its relation to the air impinged thereon adjusted and reducing more or less the volume of air delivered by the air delivery device.

To provide means for controlling and adjusting the position of the blades, while the impeller is being driven and without stoppage thereof, there is provided a shoe moving member comprising a wedge-shaped cam member 41 operatively positioned between and contacting with adjacent ends 43 of the two shoes. The cam member 41 may be moved outwardly to force apart the shoes and shift the position of the movable blades 17a by means of a radial rod 45 on which it is carried, the rod being guided in lugs 47 on the plate 11 and normally held inward, in the full line position indicated in Figs. 2 and 3, by means of a compression spring 49 between one of the lugs and an abutment 51 on the rod.

The opposite or inner end of the rod abuts against the cam member 53 carried by a sleeve 55 mounted on the hub 13 and adapted to slide axially thereon for a limited distance under the guidance of the pin 57 carried by the hub and passing through a slot 59 in the sleeve. The movement of the sleeve 55, acting through the cam 53, serves to control the position of the rod 45, the cam member 41, the shoes 35 and the movable blades 17a.

Means responsive to changing air conditions, and herein to temperature conditions, are provided to adjust the movable blades while the impeller is being driven, the same comprising cam-moving, thermostatically-actuated means in the form of an expansion device mounted on the hub 13 and responsive to the temperature of the air passing through the impeller itself. This device has a closed, corrugated, metallic, cylindrical bellows body 61, one end of which is fixed by being secured to the annular plate 63 fastened to the end of the hub 13, while its opposite end 65 is attached to the cam sleeve 55. The bellows is filled with any suitable gaseous or other temperature-responsive, expansible medium, such, for example, as methyl chloride, so that as the temperature of the air passing through the impeller rises beyond the point for which the bellows is adjusted, the latter expands and moves the sleeve and cam 53 to shift the position of the movable blades to a less effective air delivery position.

At temperatures below the point at which the bellows is designed to act, the movable end plate 65 is held by an adjustable resilient device at its extreme contracted position, as determined by the pin 57. Two or more such devices are preferably employed, as indicated in Fig. 2, one of which appears in the section in Fig. 1. Each such means comprises a compression spring 67 seated at one end against the plate 65 and centered about the pin 69 secured to the plate. The opposite end of the spring abuts against a cap 71 which is fixed on a thimble 73 secured to an adjusting screw 75 threaded in the walls of the plate 11, so that, by turning the exterior head of the screw, the compression exerted by the spring against the bellows may be adjusted and the critical temperature at which the bellows will act to move the blades may be adjustably varied as required.

Accordingly, when the temperature of the air exceeds the critical point at which the bellows is set, the latter expands slightly, cutting down the volume of the air delivered. A further temperature rise will be accompanied by a further movement of the bellows, a further movement of the blades and a further reduction in the air volume, until there is reached the extreme position of the blades permitted by the slots 31 and cams 33.

The impeller may be provided with suitable means to counterbalance the rod 45 and its connected parts, as by the provision of a diametrically opposite counterbalancing weight 77 applied to the inner face of the plate 11.

The reverse action, that is to say, an increase in the volume of air delivered in the case of a rise in air temperature, may be provided by reversing the operation of the blade controlling means. This may be controlled in various ways, as, for example, by rearranging the operation of the bellows and its cam, or by use of a different form of cam member engaging the shoes 35. In Fig. 5 there is shown a modification of

the latter sort, in which the rod 45 carries a cam member 79, the latter so shaped that in its inner or normal position it holds the shoes separated and the movable blades shifted to deliver a relatively lower volume of air. When the temperature rises beyond some predetermined point, the rod 45 is moved outwardly as previously described, but the shoes thereupon move to shift the blades 17a further toward the full line position shown in Fig. 3, so that the volume of air delivered is increased.

In Fig. 6 there is shown an air delivery device having an impeller substantially similar to that illustrated in Figs. 1 and 4, but equipped with means, herein electrical, for controlling the position of the movable blades and the volume of air delivered, the same being actuated by a device thermally responsive to the air in the space to be air conditioned, and positioned either near to or remote from the air delivery device.

For this purpose the sleeve 55 has a rigid connection 81 to the core 83 of a solenoid 85, which, when energized, serves to move the sleeve 55 and its cam 53 toward the plate 11 and force the rod 45 and its cam member 41 outwardly, either to reduce or to increase the volume of air delivered, as the case may be.

A spring 87 bearing at one end against a movable abutment 89 secured to the end of the core 83 and at the opposite end against a fixed abutment tends to draw the sleeve to the full line position shown in Fig. 6.

The solenoid is placed in circuit with a thermostat 91 positioned exteriorly to the air delivery device, and either near to or remote therefrom, and adapted, when any predetermined air temperature is reached in the space in which it is located, to energize the solenoid and move the sleeve.

In the drawings, the circuit arrangement is indicated diagrammatically only and comprises connections 93 and 95 leading from the terminals of the solenoid winding to collector rings 97 on the outside of the plate 11 and insulated therefrom, these being engaged by brushes 99 which may be mounted on the inner walls of the housing and are connected in circuit with the thermostat 91.

The latter may be of the step by step type, such that, after being first actuated to engage the solenoid and move the sleeve a certain distance, a further rise or drop in the temperature, as the case may be, will serve to increase the energizing current, extend the movement of the sleeve, and further decrease the volume capacity of the impeller.

While there is herein shown and described for the purposes of illustration one embodiment of

the invention in one specific form of impeller and one application thereof, it is to be understood that the principles of the invention may be embodied in various forms of air delivery devices and may have a great variety of applications, and further that extensive deviations may be made in the form, dimensions and relative arrangement of parts, all without departing from the spirit of the invention.

I claim:

1. An air impeller of the squirrel cage type having an air delivery device comprising a hub provided with opposed plate-like supports, one with a central air admission orifice, a series of peripherally arranged, transverse impelling blades extending between the supports, movable blade supporting means on said supports, a blade adjusting member carried by one of said supports comprising a generally arc-shaped shoe and movable on said support simultaneously to change the angular position of a plurality of blades, a shoe moving member, and means mounted on the hub of the impeller for actuating said shoe moving member while the impeller is being driven.

2. An air impeller of the squirrel cage type having an air delivery device comprising a hub provided with opposed plate-like supports, one with a central air admission orifice, a series of peripherally arranged, transverse, impelling blades extending between the supports, blade supporting means on and providing for blade adjustment relative to said supports, a blade adjusting member carried by one of said supports comprising a generally arc-shaped shoe and movable on said support simultaneously to change the angular position of a plurality of blades, a shoe moving member, and means mounted on the hub and responsive to the temperature of the air passing through said impeller for actuating said shoe moving member.

3. An air impeller of the squirrel cage type having an air delivery device comprising a hub provided with opposed plate-like supports, one with a central air admission orifice, a series of peripherally arranged, transverse impelling blades extending between and variably positioned by the supports, a blade adjusting member movably carried by one of said supports and operatively related to the blades, an actuating member for moving said blade adjusting member to change simultaneously the angular position of a plurality of blades, and means mounted on the hub of the impeller and responsive to the temperature of the air passing through the impeller for operating said actuating member while the impeller is being driven.

GEORGE B. WAGNER.