May 26, 1925. 1,539,717

F. H. C. COPPUS

REGULATION OF MOTOR DRIVEN BLOWERS

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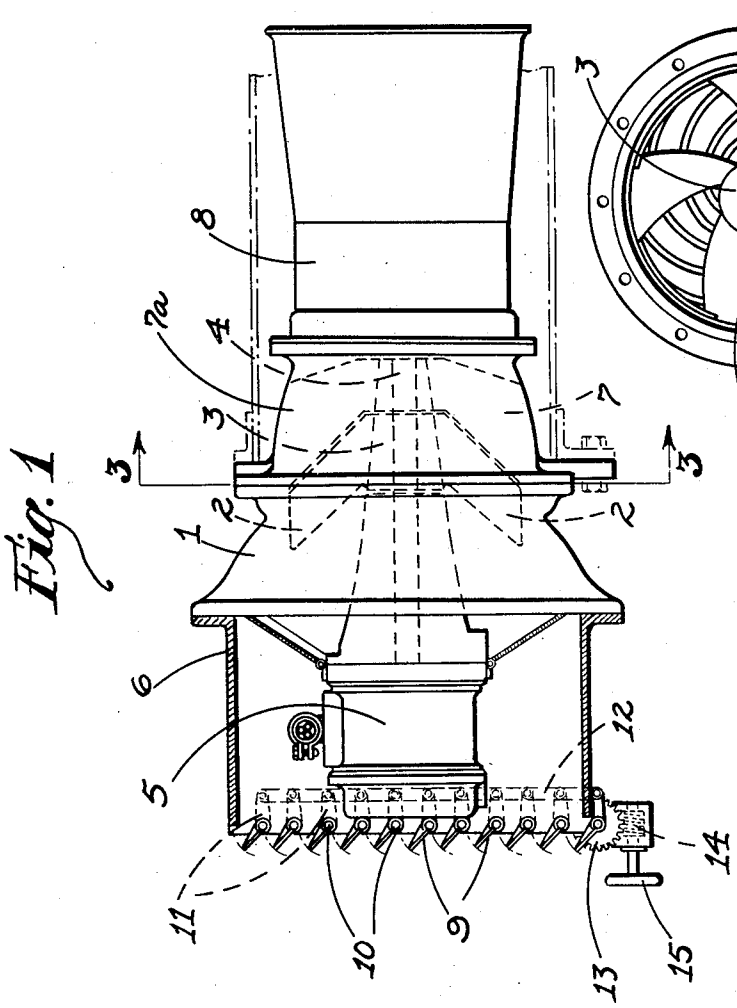


Fig. 1

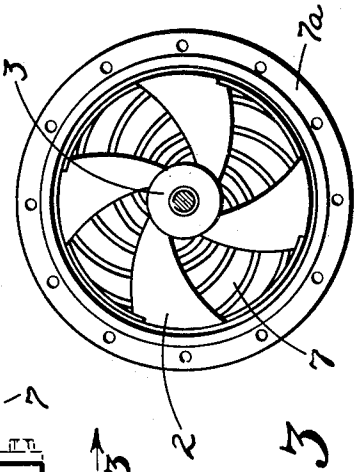


Fig. 3

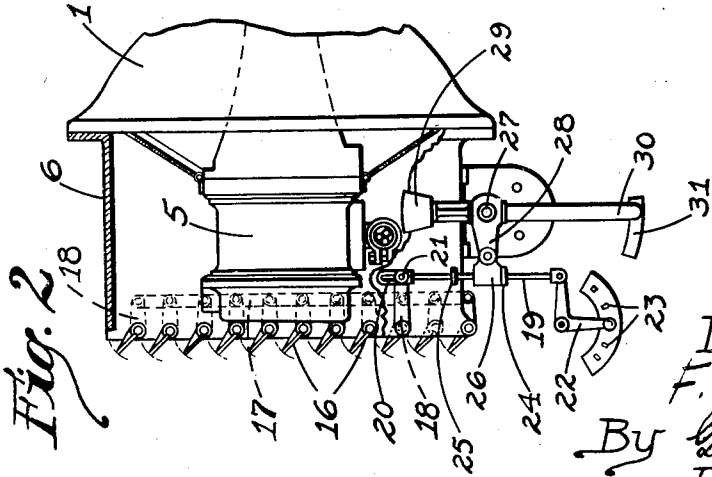


Fig. 2

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UNITED STATES PATENT OFFICE.

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REGULATION OF MOTOR-DRIVEN BLOWERS.

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To all whom it may concern:

Be it known that I, FRANS H. C. COPPUS, a citizen of the United States, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, have invented a new and useful Improvement in a Regulation of Motor-Driven Blowers, of which the following, together with the accompanying drawings, is a specification.

My invention relates generally to motor driven blowers, such as are employed for purposes of ventilating and drafting. The object of my invention is to provide an improved arrangement of the parts of a blower in connection with improved means for regulating the volume and pressure of the air delivered by the blower, whereby the amount of power consumed by the motor in driving the blower remains substantially constant at a given speed of the motor, irrespective of the volume and pressure of the air delivered by the blower.

Motor driven blowers, as heretobefore constructed have not been notably successful, owing to the fact that the power consumed by the motor varies greatly with the volume and pressure of the air delivered by the blower, so that it is extremely difficult to accurately determine the proper size of motor to employ for driving a blower which it is desired to operate at varying discharge pressures and rates of air delivery. When operating blowers of the centrifugal type, it is known that with a blower driven at a given speed, the power required to drive the blower varies directly with the effective area of the discharge opening, so that the blower motor must be able to develop enough power to drive the blower with the damper fully open if necessary, without being overloaded. This condition has resulted in the practice of providing motors which are able to develop much more power than that which would ordinarily be required to drive the blower with the discharge opening partially restricted, as during normal operation of the blower.

When operating blowers of the propelled type, the conditions described above, with respect to centrifugal type blowers, are reversed, for the propeller type blower consumes the least power when the blower inlet or outlet is fully open, and there is a minimum amount of resistance to the blower. Consequently, the power consumption of a propeller type blower increases rapidly as the inlet or outlet is restricted, and if, during the operation of a motor driven propeller blower, the inlet or outlet should become completely closed or the passage of air be otherwise obstructed, it is obvious that the power consumption of the motor would be so great as to cause it to be burned out. Here again, with blowers of the propeller type, the motor must be able to develop more than enough power to meet the extreme operating conditions.

From the foregoing, it is apparent that either centrifugal or propeller type blowers must be provided with much larger motors than the normal operating conditions require, which greatly increases the first cost of the installation and, furthermore, results in inefficient operation of the motors when driving the blowers under ordinary load conditions.

By my invention I propose to provide an improved arrangement of the parts of a propeller type blower, whereby the power consumption of the motor will remain substantially the same at a given speed, irrespective of the volume and pressure of the air delivered by the blower, which may be readily regulated by means of a damper or valve. These and other advantageous features of my invention will hereinafter more fully appear, reference being had to the accompanying drawings, in which—

Fig. 1 is a view, partially in section, and partially in side elevation, of a motor driven blower embodying my invention.

Fig. 2 is a view of the portion of the parts shown in Fig. 1, illustrating a modification in the operation of the damper for controlling the discharge of the blower.

Fig. 3 is a transverse sectional view along the line 3—3 of Fig. 1.

Like reference characters refer to like parts in the different figures.

Referring to Fig. 1, the blower generally consists of a frusto-conical casing 1, within which is adapted to rotate a plurality of

curved propeller blades 2 formed on a hub 3 which is mounted upon, and keyed to, a shaft 4. The shaft 4 is directly connected to the armature shaft of an electric motor 5 which is located within a casing 6 attached at one end to the casing 1. The other end of the casing 6 is provided with a regulating device, which will be hereinafter described.

A plurality of curved guide vanes 7 are arranged within a casing 7ª beyond the casing 2, and are arranged to direct the air delivered by the blades 2 into a diffusing tube 8 which is connected at one end to the casing 1 and is open at its other end. As best shown in Fig. 3, the curvature of the guide vanes 7 is opposite to the curvature of the propeller blades 2, so that the edges of the vanes 7 are substantially at right angles to the edges of the blades 2. With this arrangement of blades 2 and vanes 7, I have discovered that when the shaft 4 is driven at a given speed by the motor 5, the power consumed by the motor 5 in driving the blades 2 remains substantially constant for reasons which will hereinafter appear, irrespective of the volume and pressure of the air delivered by the blower, which is adapted to be controlled by means of a regulating device which will now be described.

A plurality of shutters 9 are respectively mounted on shafts 10 at the open end of the motor casing 6. Each shutter 9 is provided with an arm 11, by means of which it may be turned on its pivot, and all of the arms 11 are connected by a link 12 through which all of the shutters 9 may be turned in unison. The pivot shaft 10 of one of the shutters 9 is extended, and has mounted thereon a worm wheel 13 which is in mesh with a worm 14. The worm 14 is journalled on the casing 6 and is adapted to be turned by means of a hand wheel 15. By turning the hand wheel 15, the shutters 9 may all be moved in unison to regulate the effective area of the inlet opening to the blower casing 1. In this way, the volume and pressure of the air delivered by the blower, with the propeller blades 2 driven at a given speed by the motor 5, may be readily controlled and the blower will operate at various inlet openings with the consumption of a substantially constant amount of power by the motor 5.

While the above described means of regulating the output of the blower by means of the shutters 10 is effective under ordinary operating conditions, yet it will be readily seen that it is possible to so restrict the air inlet that hardly any air would be delivered by the blower, while the motor would continue to operate at substantially the same speed as before. While such a condition of operation would not in any way endanger the motor 5, yet it would result in a useless expenditure of power. In order to guard against the possibility of the motor 5 being allowed to run by a careless operator after the shutters 9 have been substantially closed, I provide means whereby the motor 5 will be automatically disconnected from its source of power should the shutters 9 be closed beyond a predetermined point.

Referring to Fig. 2, the shutters 16 are connected by a suitable link 17 in the same manner as the shutters 9 in Fig. 1, and one shutter is provided with an arm 18, by means of which all of the shutters 16 may be moved in unison. A vertically movable rod 19 is provided at its lower end with a slot 20, within which is received a pin 21 connected to the arm 18. The upper end of the rod 19 is connected to a suitable damper regulator which may be of any desired form and is here shown, for the purpose of illustration, as a bell crank lever 22, which may be moved into any one of a number of different positions that are indicated by notches 23 to represent varying degrees of shutter opening. The rod 19 is provided with a pair of adjustable stops 24 and 25, between which a head 26 is adapted to move. The head 26 is connected to a rocker shaft 27 by means of a link 28, and a weight arm 29 is mounted to turn with the shaft 27. A switch arm 30 is also mounted on the shaft 27 and is adapted to make contact with a segment 31. The arm 30 and the segment 31 are connected in the control circuit of the motor 5, so that when the arm 30 is in engagement with the segment 31, the motor 5 will be connected to a suitable source of electrical energy, not shown.

With the damper regulator lever 22 in the position shown, the shutters 16 are partly open and the weight arm 29 is substantially in a vertical or balanced position. Should the lever 22 be moved to the right to open the shutters 16 further, the stop 24 will engage the head 26 and move it upward, whereupon the shaft 27 will be turned enough to cause the weight to fall to the right. This movement of the weight arm 29 causes the switch arm 30 to move to the left along the segment 31, so that the motor 5 will remain connected to the source of energy as long as the lever 22 occupies any one of its several positions to the right of the position shown in Fig. 2. If, however, the lever 22 should be moved to the left of the position shown in Fig. 2, to close the shutters 16 beyond a predetermined point, the upper stop 25 will engage the head 26 and cause the weight arm to fall to the left, thereby causing the switch arm 30 to move off the segment 31 and disconnect the motor 5 from the source of energy. The motor 5 will remain disconnected so long as the shut-

ters 16 are closed beyond the predetermined point, but the lower stop 24 will engage the head 26 and move the switch arm 30 into engagement with the segment 31 again as soon as the shutters 16 are opened enough to raise the weight arm 29 to a substantially vertical position. Obviously, the exact degree of shutter opening at which the motor is connected or disconnected can be predetermined by properly positioning the stops 24 and 25 on the rod 19. Obviously also, the shutters 16 can be operated by a hand wheel, as in Fig. 1, and yet be associated with the weight arm 29 and switch arm 30 to automatically connect and disconnect the motor 5, in accordance with the degree of shutter opening.

As previously stated, I have discovered that the power consumed by the motor 5 in driving the blades 2 remains substantially constant, irrespective of the volume and pressure of the air delivered by the blower, and I attribute this result to the coaction between the blades 2 and the vanes 7 when the blower is delivering air. The function of the vanes 7 in my improved arrangement is to transform the dynamic pressure of the air delivered thereto by the blades 2 into static pressure, and it is largely due to this action of the vanes 7 that the power input of the blower remains constant under different conditions. I have discovered by actual test that when the blades 2 are driven with the shutters 9 entirely closed, the motor shows a certain power consumption which remains substantially constant as the shutters are opened. With the above described function of the vanes 7 in mind, it would therefore seem that as the shutters 9 are opened, the dynamic pressure represented by the velocity of the air leaving the blades 2 is transformed into static pressure by impact with the vanes 7, so that the power consumption of the motor remains constant as long as its speed remains the same. In other words, the motor has substantially the same resistance to overcome in driving the blades 2, irrespective of whether the vanes 9 are fully opened or fully closed.

From the foregoing, it is apparent that I have provided an improved arrangement of the parts of a propeller type blower whereby the power consumed by the motor which drives the blower remains substantially constant, irrespective of the volume and pressure of the air delivered by the blower, and whereby these quantities may be readily varied by my improved regulating device, which is adapted to automatically connect and disconnect the motor in accordance with the degree of shutter opening. While I have shown my invention as embodied in a particular arrangement of parts, it is not so limited but is susceptible of various modifications within the scope of the appended claims.

I claim,

1. In a blower, the combination with a set of propeller blades driven at a predetermined speed and means for varying the volume and pressure of the blower discharge, of means for maintaining the power required to drive the blower constant for different rates of discharge.

2. In a blower, the combination with a set of propeller blades driven by a constant speed motor and means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, of means for regulating the volume and pressure of the blower discharge.

3. In a blower, the combination with a set of propeller blades driven by a constant speed motor and means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, of means for automatically controlling the operation of said motor in accordance with the volume and pressure of the blower discharge.

4. In a blower, the combination with a set of propeller blades driven by a constant speed motor and means cooperating with said blades for maintaining the power consumption of said motor constant for varying degrees of blower discharge, of an adjustable damper device for controlling the volume and pressure of the blower discharge.

5. In a blower, the combination with a set of propeller blades driven by a constant speed motor and means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, of an adjustable damper device for controlling the volume and pressure of the blower discharge, and means for controlling the operation of said motor in accordance with the setting of said damper.

6. In a blower, the combination with a set of propeller blades driven by a constant speed motor, means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, and an adjustable damper device for controlling the volume and pressure of the blower discharge, of means for automatically controlling the operation of said motor in accordance with the setting of said damper.

7. In a blower, the combination with a set of propeller blades driven by a constant speed motor, means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, and an adjustable

damper device for controlling the volume and pressure of the blower discharge, of means for automatically starting said motor when said damper device is opened a predetermined amount.

8. In a blower, the combination with a set of propeller blades driven by a constant speed motor, means cooperating with said blades for maintaining the power consumption of said motor constant for varying rates of blower discharge, and an adjustable damper device for controlling the volume and pressure of the blower discharge, of means for automatically stopping said motor when said damper device is closed a predetermined amount.

Dated this 25th day of October, 1921.

F. H. C. COPPUS.