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TRANSVERSE FLOW BLOWERS HAVING CONTROLLED SECONDARY FLOWS

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Fig. 2

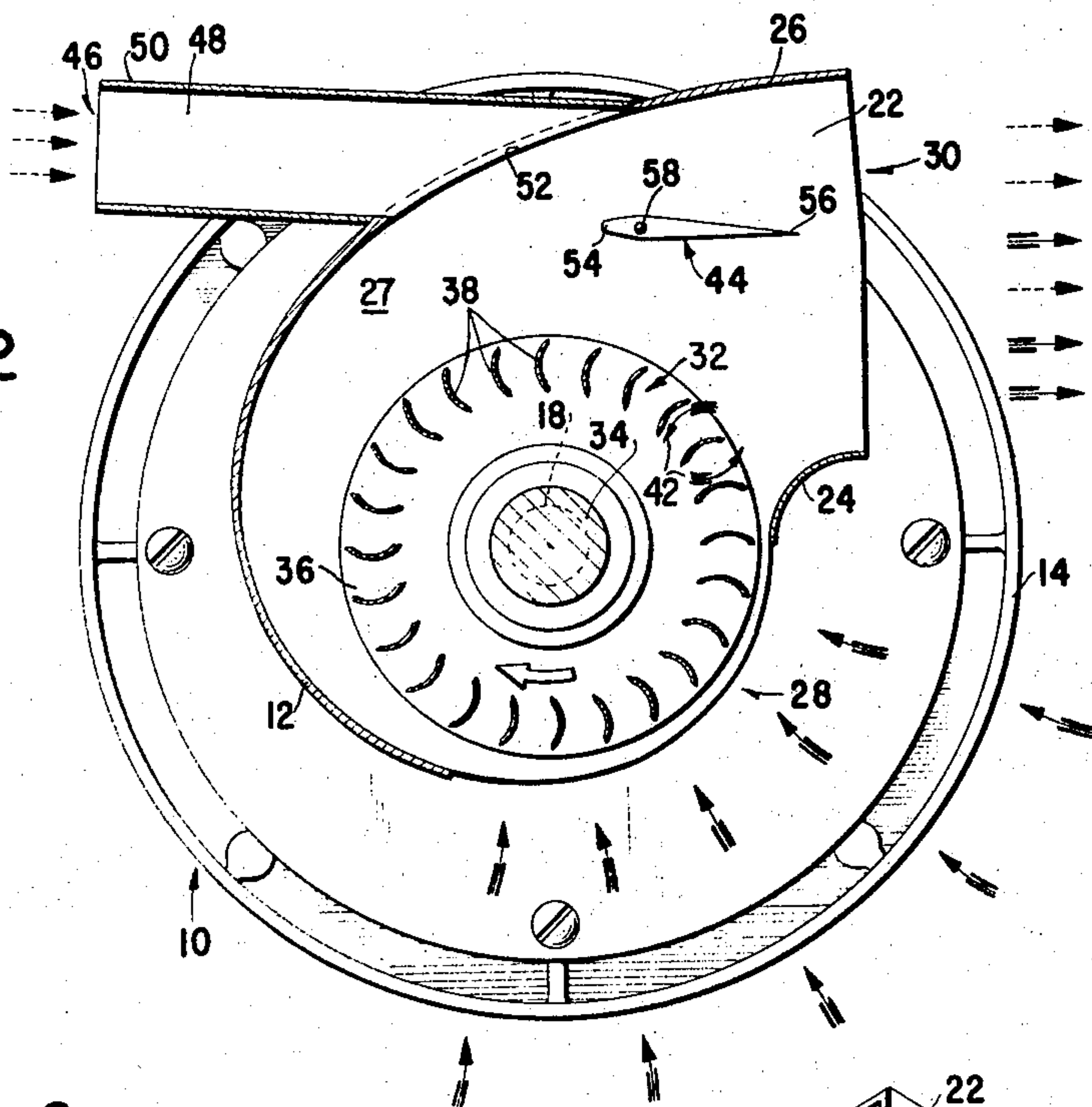


Fig. 1

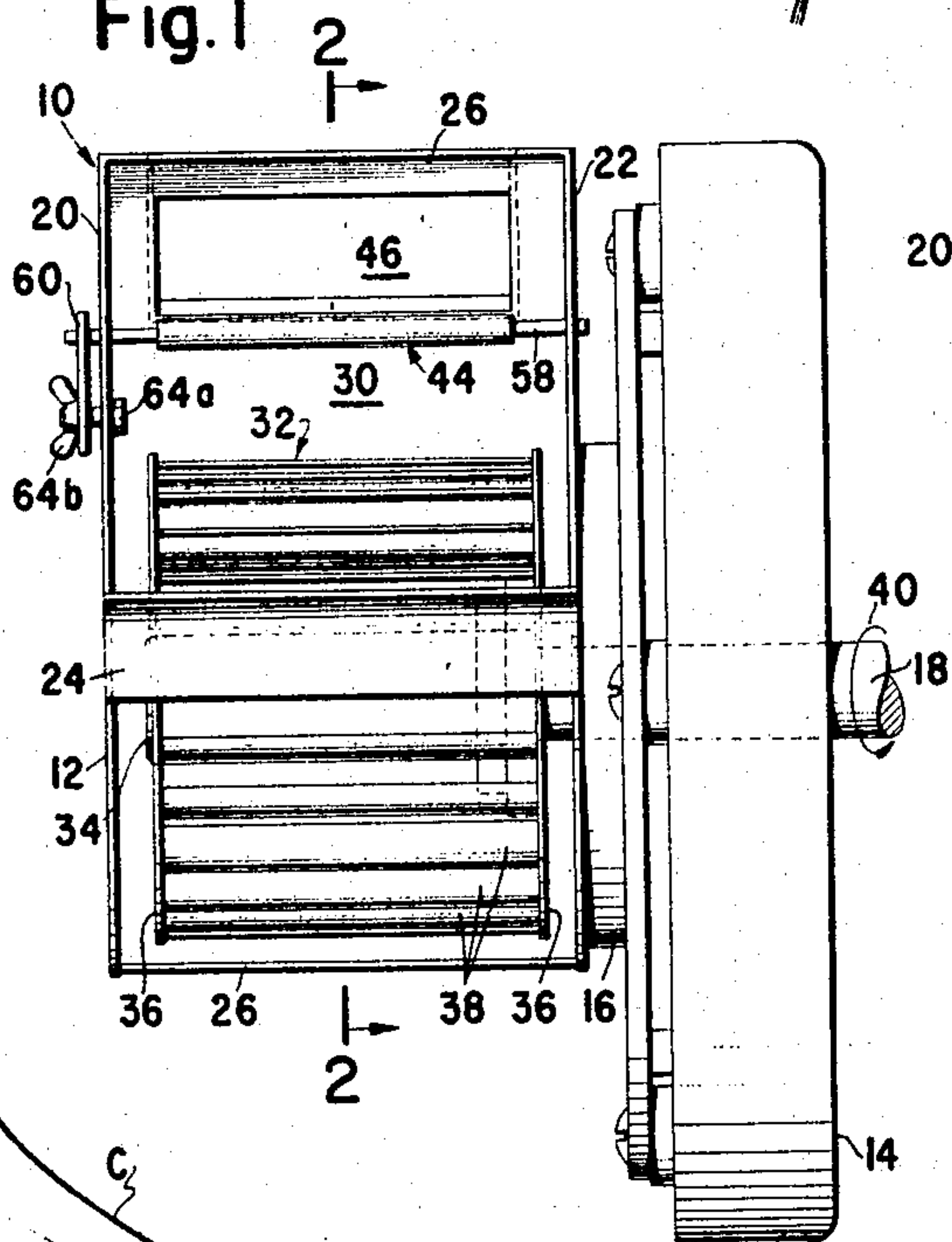


Fig. 3

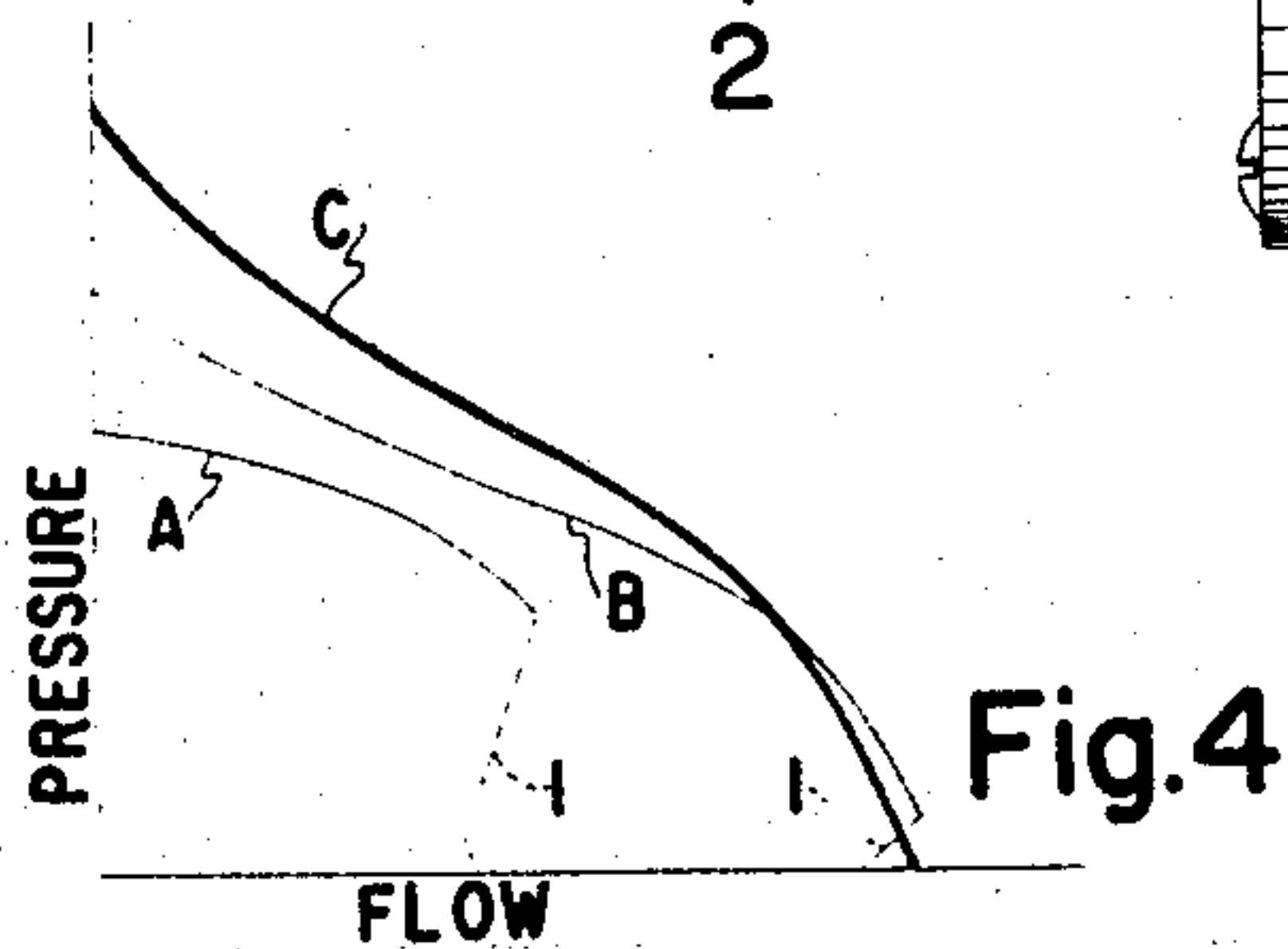
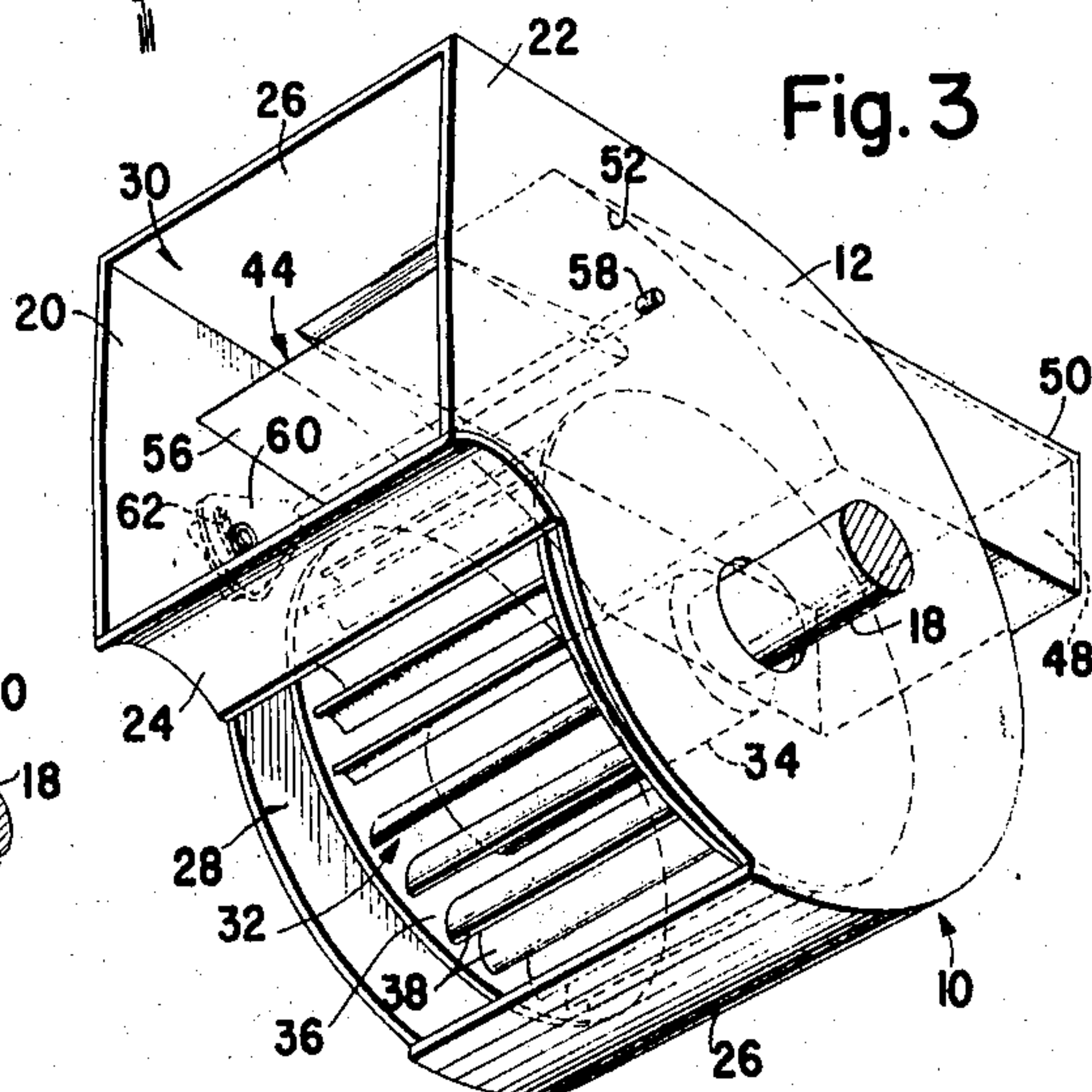


Fig. 4

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2 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a transverse flow blower. More particularly the disclosure relates to a transverse flow blower having an induced secondary flow that is prevented from contacting the impeller by a control vane. Furthermore, transverse flow blower may serve as a pneumatic conveyor by having the secondary flow include solid particles.

Background of the invention

Heretofore the prior art has recognized that changes in the rate of flow through a transverse flow blower from its optimum pressure may result in severe pressure drops. In multiple rotor blowers, induction slots between the rotors have been used to supplement the throughput of the blower. However, little is known of the instability of flow, pressure and impeller speed that has been found to occur when the blower discharges its throughput at or near atmospheric pressure, which might also be termed "free air delivery operation." The underlying aerodynamic cause of the phenomenon resulting in this instability is not fully understood. The instability in the conventional transverse flow blower may be characterized by a variation in blower flow rate, static discharge pressure and impeller speed. It was found that the three parameters increase or decrease together. Aside from the occurrence of the instability near free air delivery operation, the resulting instability occurs with no apparent pattern or frequency and has been observed during both increasing and decreasing modes. In their preoccupation with devising various vortex forming means including stabilizing vanes the occurrence of instability near free air delivery operation was either overlooked or ignored by earlier inventors.

Summary of the invention

In accordance with the present invention the novel transverse flow blower is provided with a housing having an inlet and a discharge. An impeller having tangential vanes is rotatably mounted in the housing to generate a primary flow from the inlet to the discharge. A secondary inlet is formed in the housing downstream of the first mentioned inlet and has a secondary flow induced therethrough by the primary flow from the impeller. A control vane is connected in the housing to prevent instability in the throughput flow of the blower.

It is therefore an object of the present invention to provide an improved transverse flow blower which eliminates instability of flow, pressure and impeller speed near free air operation; which is simple, economical and reliable; which may function as a pneumatic conveyor of solid particles that are induced into the throughput of the blower without contacting the impeller; which has an impeller induced secondary flow that is controlled by a vane; which has an adjustable control vane for controlling the secondary flow and preventing the secondary flow from contacting the impeller; which has control vane disposed on the division stream line between the primary and secondary flow; which provides for an increase in the maximum discharge static pressure over that otherwise obtain-

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able in existing transverse flow blowers; and, in which improves the flow rate of the blower.

Other objects and advantages will be apparent from the following description of one embodiment of the invention and the novel features will be particularly pointed out hereinafter in the claims.

Brief description of the drawings

This invention is illustrated in the accompanying drawings in which:

FIGURE 1 is a front elevational view of a transverse flow blower embodying the present invention.

FIGURE 2 is a sectional view taken along line 2-2 of FIGURE 1.

FIGURE 3 is a perspective view of the transverse flow blower embodying the present invention.

FIGURE 4 is a graphic representation of pressure-volume curves A for a conventional transverse flow blower, B for a modified transverse flow blower, with the unstable areas of curves A and B indicated by the dotted portions I; and the C curve for the transverse flow blower embodying the present invention.

Description of the invention

In the embodiment of the invention illustrated in FIGURES 1, 2 and 3 the transverse flow blower is designated generally as 10, and has a housing 12 that is suitably connected to a motor casing 14 by an annular connecting member 16 through which a drive shaft 18 from the motor (not shown) passes into the housing 12. Housing 12 includes side walls 20 and 22 disposed in spaced relation to each other, with side wall 22 being connected to annular member 16. A transverse inner wall 24 and an arcuate transverse outer wall 26 are connected at either end to side walls 20 and 22 to define a hollow chamber 27 therebetween. An inlet 28 is formed between the lower edges of the inner wall 24 and the outer wall 26. A discharge 30 is formed between the upper edges of the inner wall 24 and the outer wall 26. Inlet 28 and discharge 30 extend substantially transversely of housing 12 and are bounded by side walls 20 and 22.

An impeller or rotor 32, in the form of a hollow cylinder, is suitably mounted to drive shaft 18 as by a connecting hub member 34 which extends between the end closures 36 of the impeller. A plurality of transverse vanes 38 are connected between the end closures 36 and are concavely curved in the direction of impeller rotation, which direction is indicated as clockwise as viewed in FIGURE 2 by the arrow designated generally 40.

In the conventional transverse flow blower the flow may be assumed to be air and for convenience will be depicted as corresponding to the primary flow of the present embodiment. Accordingly the primary flow will be drawn into the inlet 28 to pass radially through vanes 38 in a direction transverse to the impeller axis prior to being discharged from the hollow interior of impeller 32 on the side thereof remote from inlet 28, also in a radial direction through vanes 38 to exit from discharge 30. A whirling air vortex 42, schematically shown by the two semicircular arrows, in FIGURE 2 is formed adjacent the inner wall 20 between this wall and a control vane 44 with its center usually inside the impeller 32, to rotate in the same direction as the impeller, in a manner well known in the art.

Inlet 28 could be likened to the upstream side of the primary flow in which case discharge 30 would be analogous to the downstream side of the flow. In this instance the terms upstream and downstream would find analogy in the general run of a river wherein the source of the river would be "upstream" and correspond to the location of the inlet 28, while the mouth of the river would be

"downstream" and correspond to the position of the discharge 30.

As was referred to earlier, if the primary flow is taken alone, as it nears free air delivery operation, wherein the static pressure head at the discharge approaches zero, the phenomenon of instability of flow, pressure and impeller speed will occur. The present invention completely eliminates this instability by providing an induced secondary flow which is modulated by a control vane or airfoil 44 that is transversely disposed on the discharge side of impeller 32 and also serves to insure against the induced secondary flow coming into contact with the impeller. Accordingly the construction embodied in the present invention may in addition to functioning in a more efficient manner as a transverse blower per se, permit the novel transverse flow blower 10 to be used as a pneumatic conveyor for a wide range of solid particles. For example, material introduced into the secondary flow and ranging from grain to abrasives may be conveyed without causing damage to the particles, in the case of the grain; and without causing damage or excessive wear to the impeller 32, in the case of the abrasive particles.

The secondary flow is obtained through a secondary inlet 46 which may be in the form of a slot means 48 having a duct 50 that connects to outer wall 26 so as to completely surround a rectangular slot 52 formed therein. The secondary inlet 46 is formed intermediate inlet 28 and discharge 30 and may be disposed on the discharge side of impeller 32. The total throughput flow of blower 10 will consist of the primary flow and the induced secondary flow.

Control vane 44 will have suitable aerodynamic design features such as an arcuate leading edge 54 that smoothly increases the width of the airfoil a short distance prior to gradual tapering for a much longer distance, into a thin trailing edge 56. A rod 58 is fixedly connected through vane 44 and extends through side walls 20 and 22 to mount vane 44 at a predetermined position in housing 12 so as to locate vane 44 at the division stream line between the primary and secondary flows so as to separate said flows. The end of rod 58, which passes through side wall 20 is connected adjacent the apex of a triangularly shaped crank arm 60, the base side has an arcuate slot 62 which may be adjustably positioned to set the "angle of attack" of the airfoil by means of a bolt and wing nut, 64a, and 63b, respectively. The term "angle of attack," may be defined as that acute angle which lies between the chord of the airfoil and the line of the undisturbed relative air flow. By providing for the angular adjustment of vane 44 it will be possible to modulate the flow by varying said angle of attack. The airfoil 44 may serve a dual function of (1) preventing instability from occurring in the flow, pressure and impeller speed when the discharge pressure is near air delivery operation, and (2) preventing the secondary flow from coming into contact with impeller 32. Manual adjustment means for vane 44 have been shown but it is within the scope of the present invention to include automatically adjusted means.

FIGURE 4 is a graphic representation of various transverse flow blower constructions. The A curve represents a conventional transverse flow blower. The curve shows a gradual decrease in static pressure on increase of flow up to a point where the curve abruptly breaks into an area indicated by the dotted line under the I that represents the appearance of instability which continues almost to the point to zero pressure.

The B curve represents a transverse flow blower having a secondary inlet and once again the unstable condition is indicated by the dotted line under the I showing the area of instability at the extreme right of the curve. The maximum pressure of the B curve is slightly greater than the conventional transverse flow blower, however, the re-

occurrence of the instability phenomenon would greatly limit its effective use.

The C curve represents the present invention in which a control vane co-acts with the secondary flow to completely eliminate the occurrence of the instability phenomenon. Furthermore, such a construction provides for a greatly improved maximum static discharge pressure over that otherwise obtainable, in addition, to being able to serve as a pneumatic conveyor.

It will be understood that various changes in the details, materials, arrangements of parts and operating conditions which have been herein described in order to explain the nature of the inventions may be made by those skilled in the art within the principles and scope of the invention as expressed in the claims.

Having thus set forth the nature of the invention, what I claim herein is:

1. In a transverse flow blower having a throughput flow made up of a primary flow and a secondary flow induced thereby, the combination of:

- (a) a housing having transverse inner and outer walls extending between spaced side walls to define a hollow chamber therebetween,
- (b) a primary inlet in communication with the hollow chamber formed in the housing on one side of the inner wall,
- (c) a discharge in communication with the hollow chamber formed in the housing on the other side of the inner wall,
- (d) an impeller, having tangential vanes, rotatably mounted in the hollow chamber of the housing on the side thereof adjacent the primary inlet to generate a primary flow therethrough from the primary inlet to the discharge,
- (e) a secondary inlet in communication with the hollow chamber formed downstream of the primary inlet and the impeller in the outer wall of the housing whereby on rotation of the impeller said secondary inlet adapted to have a secondary flow induced there-through by the primary flow and,
- (f) a control vane adjustably connected to the housing wholly within the hollow chamber intermediate the secondary inlet and the discharge on the downstream side of the impeller, and said vane adapted to be positioned in the throughput flow to prevent the secondary flow portion thereof from coming into contact with the impeller and to minimize any instability in said throughput flow.

2. The combination claimed in claim 1 wherein:

- (a) the control vane adjustably connected to the housing wholly within the hollow chamber thereof in a predetermined spaced relationship with the impeller, the secondary inlet and the discharge.

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U.S. Cl. X.R.

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