

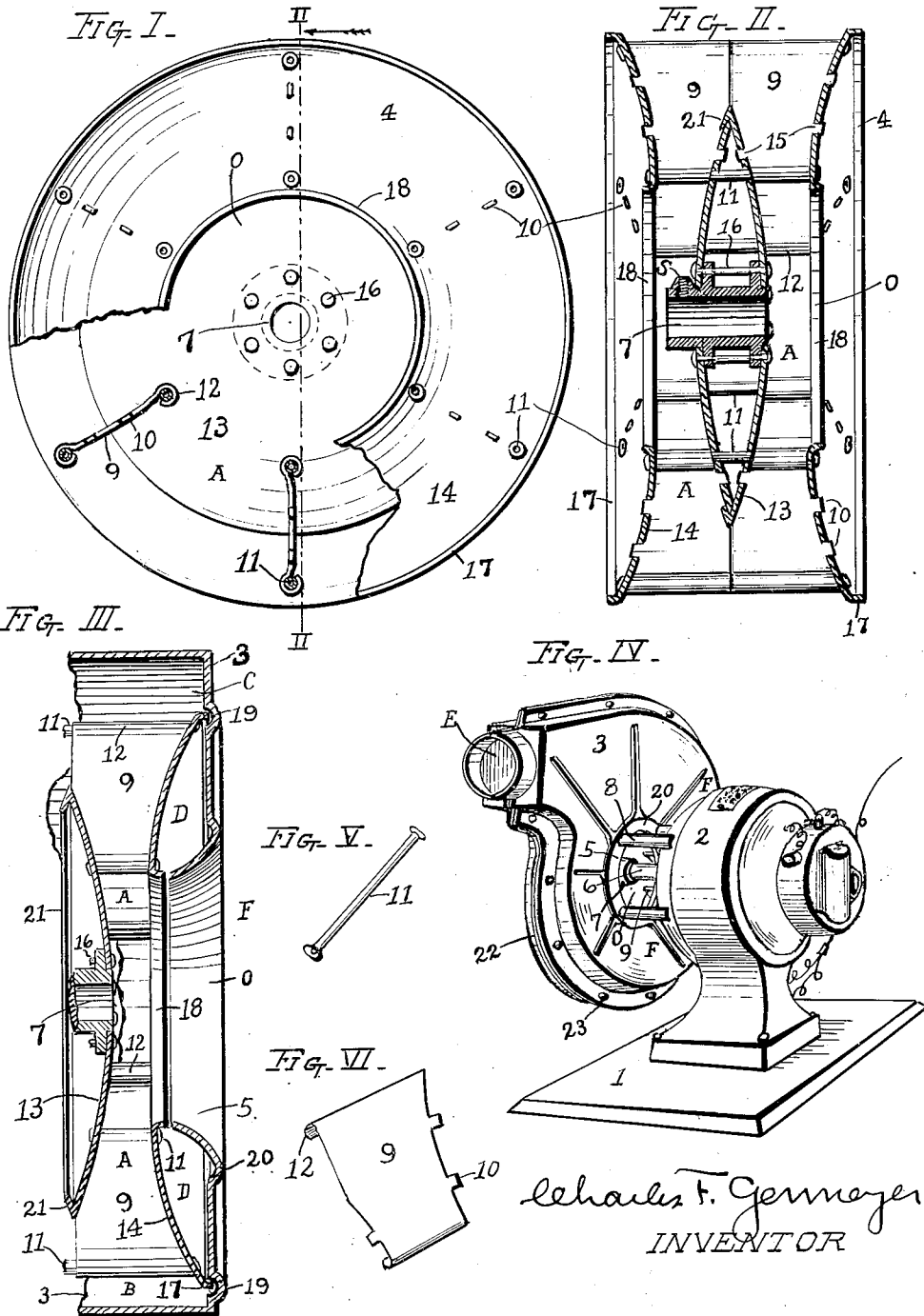
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BLOWER

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BLOWER.

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This invention relates to centrifugal blowers of a Venturi type, and its primary object is to provide a means of consuming low grade coal, such as screenings, culm and even coal dirt in furnaces for household and commercial heating purposes. It requires no campaign of education to induce householders to install blowers to make available to them, for heating purposes these cheaper forms of coal. During the past few years a number of blowers have come into the market to meet these requirements. Most of these blowers are an adaptation of old timers that in other fields gave more or less satisfaction, and under the stress of necessity have been tolerated in this work; but a clamor for something better and an endeavor on the part of the applicant to overcome the annoyances and unsatisfactory elements in the system has resulted in the improvements herein embodied.

Some of the unsatisfactory features of a blower system providing forced combustion, in a house heating furnace, are: noisiness, unevenness of temperature, low mechanical efficiency and grate bedding. Some of these obstacles have been overcome through improved instruction in firing, but only in the case of these improvements have the other undesirable elements been eliminated. A noisy and low efficiency blower certainly constitutes a consideration whether to use low priced coal under forced draft or the high priced under natural draft. This improvement reduces noisiness to a minimum and effects a much higher efficiency. That is the kilowatt consumption of the blower driving motor is materially less, as the motor required is materially smaller. This improvement is achieved upon a theory diametrically opposed to that in general practice. The principles upon which it is based are elucidated in the following discussion and illustrations:

If atmosphere may be considered a reservoir of fluid, the inlet to the blower corresponds to an orifice allowing this fluid to flow, and the opening in the rotor and the case registering therewith is made to conform with the vena contracta of the flow. The rotor blades, the heels of which, are brought closer to the axis of revolution, thus giving them less velocity for an equal angular displacement and requiring also, therefore less driving energy. Since the heels of these blades moves slower the entering air is picked up with less shock and carried through the passages of the rotor with less sacrifice of velocity with which it met the heels of the blades. The velocity of flow is accelerated by progressively reducing the area of the inlet to conform to the natural stream lines of the vena contracta flow which reach their greatest degree of convergence beyond the blade heels, at which point, following their trend, they diverge again and at the delivery points of the blades they are flared out considerably in width beyond that at the heel. It is the common practice in blower design to have the width of the blades at the periphery narrower than at the heel or base. This construction is defended by saying that theoretically no energy is destroyed, through frictional loss transmitted into heat, provided the passage for the air has uniform cross sectional area from heel to tip. In order, therefore, to secure uniform area for air travel the blades (because of their radial divergence) are made narrower at their tip than at the heel theoretically to the extent that the chord of the arc between the blades at their outer edge or tip is greater than at their center. In reference to this feature it has been demonstrated by applicant that this method of reasoning contains a fallacy, for repeated experiments, and their results incorporated in these improvements, have shown that the air flowing through the rotor does not take advantage of the full space existing between the blades in a circular direction, i. e. in a direction normal to the surface of the blades. These experiments have shown that air tends to move through the rotor in streams essentially parallel to the blade behind them. This definitely confirms that there is no economy in having the blades narrower at the tip than the heel. All energy imparted to air in a centrifugal blower is by reason of the velocity of its rotor and the velocity it imparts to the air it is handling. This velocity is, in practically all cases of blower application, too high for practical use. It is, therefore, the function of the volute casing to slow down, and gradually this velocity, and thereby

transform a portion of it from the kinetic energy of moving air to potential energy represented by static pressure of air at rest. The efficiency of a blower depends largely on the efficiency of this transformation. Thus was suggested the thought that some of this transformation might be started advantageously in the rotor for two reasons, namely: 1. Narrow blade tips proved by test a fallacy. 2. If wide tips could be used to secure some of, above named, transformation, they would also, and aside from this, have other advantages. It must be noted, however, that in actual practice it is not possible to dissociate the advantages gained by this change from kinetic to potential energy, in the rotor, from other advantages of wide blade tips. These advantages can be analyzed, however, and pointed out mathematically, within certain limits, and acceptably to any reasoning person.

In order to point out these other advantages of wide blade tips, imagine a unit volume of water being delivered at the surface of a body of water in a rectangular tank at relatively high velocity by a flume or spout, narrow in proportion to the width of the tank into which it is delivered. The result of this entering, high velocity, stream is that it thoroughly disturbs the surface of the water in the tank, and its energy, namely that of the entering jet, is largely lost in creating eddies in the body of water in the tank. Imagine again the same tank with the same unit volume of water delivered to it by a trough of the same width as the tank; the velocity of this entering stream will be proportionally less, and to the extent that the trough delivering it is wider than the one spoken of above. In other words, this unit volume of water is delivered, in the latter case, in a relatively slow moving sheet over the entire surface of the trough, and, therefore, cannot produce side eddies, for the reason already obvious, that the disturbance is uniform and organized and the velocity low.

It is fair to assume that the delivery of air from the tips of the blade into the rotor case is of the same order as the water delivered to the tank by a wide spout. Now the direction of rotor rotation is toward the outlet of the blower and as the air already present in the rotor case is delivered from this outlet, it can be seen that the air transferred from the rotor through the case is along, and in the direction of, the general movement of this air in the case. These flat streams of air from the rotor more easily align themselves, therefore, and assimilate themselves, with the streams of air that are already moving in the case.

Since it is desirable, as has been shown, to maintain high static pressure at the expense of speed of air flow, the blades are

flared out at the tips. To the extent that this widening takes place the acceleration of speed of air flow which is some ratio to the progressive increase of travel of the respective points from heel to tip of blades, is reduced. Likewise, the volute passage at the periphery of the rotor is made shallow and proportionately widened, to avoid eddying and for the other reasons just described.

Quietness so essential to blowers in this connection, results largely from treating the air in the manner already described, and along more natural lines of flow, giving it no sharp corners to encounter. All the curves are smooth and there are no obstructions or irregularities in the lines of air flow. It might be added that, although this blower is not absolutely silent, the very marked improvement in noise elimination should indicate, without further investigation, its higher efficiency.

Another feature, not yet referred to, namely, that if double, or twin, construction, enables us to take advantage, in the most economical manner, of the requirement of having long, narrow blades, with wide delivery tips. This principle has been incorporated in this blower by constructing the rotors in such a way that it is essentially two narrow-bladed blowers in one case, and in a word, and before referring to the drawings, the construction is characterized as follows: The blower, of Venturi type, is in such relation to the driving motor as to best fulfill the requirements already indicated. The blower and rotor cases are in a fixed relation to each other on a common base. The rotor in the blower case is on a shaft common with the motor armature. It is on an extension of the motor shaft and supported only by the motor's bearings. The motor shaft may be extended in both directions beyond its bearings to support two rotors operating in blower cases on either side of the motor and rigid with it on the same base; these blowers to be so arranged as to deliver in a common pipe. The blower case has an axial intake on either side. The rotor is carried on the shaft by means of a double convex disk, solid to the shaft at center. By means of this double disk the radial propelling blades thereon carry the side disks bearing specially shaped intake openings, to register with the properly contoured openings in the case together to constitute the streamline organization already understood. The blades at the delivery tips are farther out and describe a larger circle than that of the double-convex, carrying disk. The annular, side disks, carried by the blades, extend beyond the periphery of the blades. These side disks are curved inward and are closest the companion, convex, carrying-disks at a

point intermediate between the inner and outer edges of the propeller blades and from that point flare outward again to blend in a stream line with the sides of the case beyond their margin. The outside rim, in cross section, is straight, instead of curved, for the reason that the strands of air flow from the respective blade tips like the paint does from a moving brush pressed down on the articulating surface. These strands of air, like the successive coats of paint, are progressively superposed on each other by the successive delivery blades.

Attention must here be called to the striking difference in behavior and efficiency effect between the operation of this blower and the others in common use. In the common blower, where the propeller blades are common to the intake orifices of the case, the rarity engendered by their rotation causes an inrush through the opposed openings and there is collision and neutralization of the energy or force acquired by the intake suction. Aside from heat losses, the inertia of eddy currents must be overcome and organized and re-directed in a centrifugal stream, and this action is hampered by the illogical blade and delivery construction already discussed. In applicant's construction, to the contrary, the interposed, contoured carrying-disk obviates interference of the opposed intake currents, which are gently, and without shock or confusion ushered in stream lines centrifugally toward the blade tips where they are joined and reinforced by their companion stream from the complementary side of the twin rotor. The volume is not only doubled but its pressure value is somewhat heightened. There are other advantages from this retrenchment which here need not be pointed out. Suffice it to say that any tests of comparison between applicant's construction, embodied in this application, and other forms common and in commercial use, whether those tests be in the form of standard determinations by laboratory apparatus or by competitive trials in actual service the results are so markedly in favor of this construction that there can be no doubt, even in the mind of any competitor as to its superiority.

Referring now to the drawings:

Figure I is an elevation view of the rotor with a part of the annular side disk cut away to show the relation of the blades thereto and to the carrying disk on the shaft.

Figure II is a cross-section on the line II—II of Figure I, and looking in the direction of the arrow. By this figure the details of construction of the rotor may very well be understood.

Figure III is a selected portion of Figure II showing in section the relation of the rotor to the case and their vena contracta and stream-line relation to each other.

Figure IV is a perspective view of blower ready for service. The rotor case and motor case are common to and rigid with a base. The rotor and armature are common to a shaft and supported by bearings in the motor housing.

Figure V is a detail and constituting a pipette flared out at each end to serve as a rivet-head.

Figure VI is a detail of the propeller blade bearing turn-overs and riveting ears.

The rotor is preferably made of aluminum sheets which lend themselves to required conformations and at the same time afford lightness and rigidity, and that substantiality requisite of high speed rotors.

1 is the base, 2 the motor and 3 the blower. F is the outside air, O the intake orifice, A the passageways through the rotor. B is the shallow part in the volute passage, beyond the rotor, and C represents a deeper position therein. D is the dead space between the rotor and its case 3. E is the out-let end of the volute passage and is adapted to connect to a delivery pipe (not shown). 4 is the rotor; 5 the vena-contracta part of the intake opening of the case 3 and 18 is its supplement in the annular disk 14 of the rotor 4 which by means of hub 7 is mounted on drive-shaft 6 common to the motor 2. 8 is the means by which blower 3 and motor 2 are held in rigid relation to each other on base 1. 9 is the propeller blade of rotor 4 by means of which, and the pipette-stays 11, serving as bolts, rotor 4 is assembled, i. e., the solid, carrying disk 13 and annular disk 14 are held together in rigid relation. The opposed carrying disks 13 are held together, and fixed on the hub 7 by means of rivets 16 and turn-over flange 21. The hub 7 is fixed on the shaft 6 by set-screw S. The flange 17 on the rotor 4 is adapted to set into an annular race-way 19 and serves to prevent a draft of air from the pressure-canal B—C into the dead-air-chamber D. The blower-case 3 is in two parts or halves which are joined together by screws 23 through flanges 22. The manner of assembling is as follows: The Rotor: Each half is first assembled separately. The sets of blades 9, by means of their ears 10, are riveted first, and on their one side to disk 14, and then on their other side to disk 13. The two halves are then brought together, with the hub 7 interposed between the opposed carrying disks 13 in such a manner that all the parts on the one side correspond, and are symmetrical with those on the other, when the rods 11 are slipped through the registering holes and turn-overs 12, and the bolts 16 inserted at hub and all riveted at both ends. Lastly, the marginal flange 21 of the disks 13 is turned over, the hub 7 slipped over the shaft 6 and the set-screw S tightened. The case: before the rotor 4 is

slipped on the shaft 6 that side of its housing 3 next the motor is fastened to the motor-housing by attaching it to posts 8; the power shaft 6 extending through the intake opening O. The rotor is then mounted as indicated and in such relation to the housing side 3 already assembled with the motor 2 that the rotor flange 17 engages the race-way 19 in the housing to such a depth that its edge does not drag in the bottom of the race-way. The remote half is then placed in position to have the corresponding parts to match when they are secured by screws 23 through the flanges 22.

It is essential to the highest efficiency of the blower that the boundary face of its volute is straight. If it were cross-sectionally curved, as is common in blower construction, the strands of air delivered, as by a paint brush, would have their equilibrium disturbed by eddying at the highest point. It billows and breakers as the currents from both sides tending inwardly toward the line of the highest point. A paint brush drawn over a corrugated surface longitudinally demonstrates the behavior in air delivery in point. The eddying along the high line disorganizes the stream and materially the pressure flow.

Minor details of construction and conformation can be resorted to without violating the spirit of the invention.

I claim:

1. In a blower of the class described, a volute casing having an axial intake port defined by an inturned flange on said casing, and a rotor having an annular side disk which registers at its inner edge with the said flange and flares outwardly towards a side wall of the casing, said flange and side

disk conforming in contour to the vena contracta of incoming air.

2. In a blower of the class described, a volute casing having oppositely presented axial intake ports defined by inturned flanges on said casing, and a duplex rotor having annular side disks which register at their inner edges with the said flanges, respectively, and flare outwardly towards the side walls of the casing, said flanges and said disks conforming in contour to the vena contracta of incoming air.

3. In a blower of the class described, a volute casing having oppositely presented axial intake ports defined by inturned flanges on said casing, a duplex rotor having annular side disks which register at their inner edges with the said flanges, respectively, and flare outwardly towards the side walls of the casing, said flanges and said disks conforming in contour to the vena contracta of incoming air, and impeller blades carried between said side disks and flaring outwardly to substantially the whole width of the casing.

4. In a blower of the class described, a volute casing of rectangular cross section having oppositely presented axial intake ports defined by inturned flanges on said casing, a duplex rotor having annular side disks which register at their inner edges with the said flanges respectively, and flare outwardly towards the side walls of the casing, said flanges and said disks conforming in contour to the vena contracta of incoming air, and impeller blades carried between said side disks and flaring outwardly to substantially the whole width of the casing.

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