April 9, 1946. W. C. PARRISH 2,398,113

BLOWER

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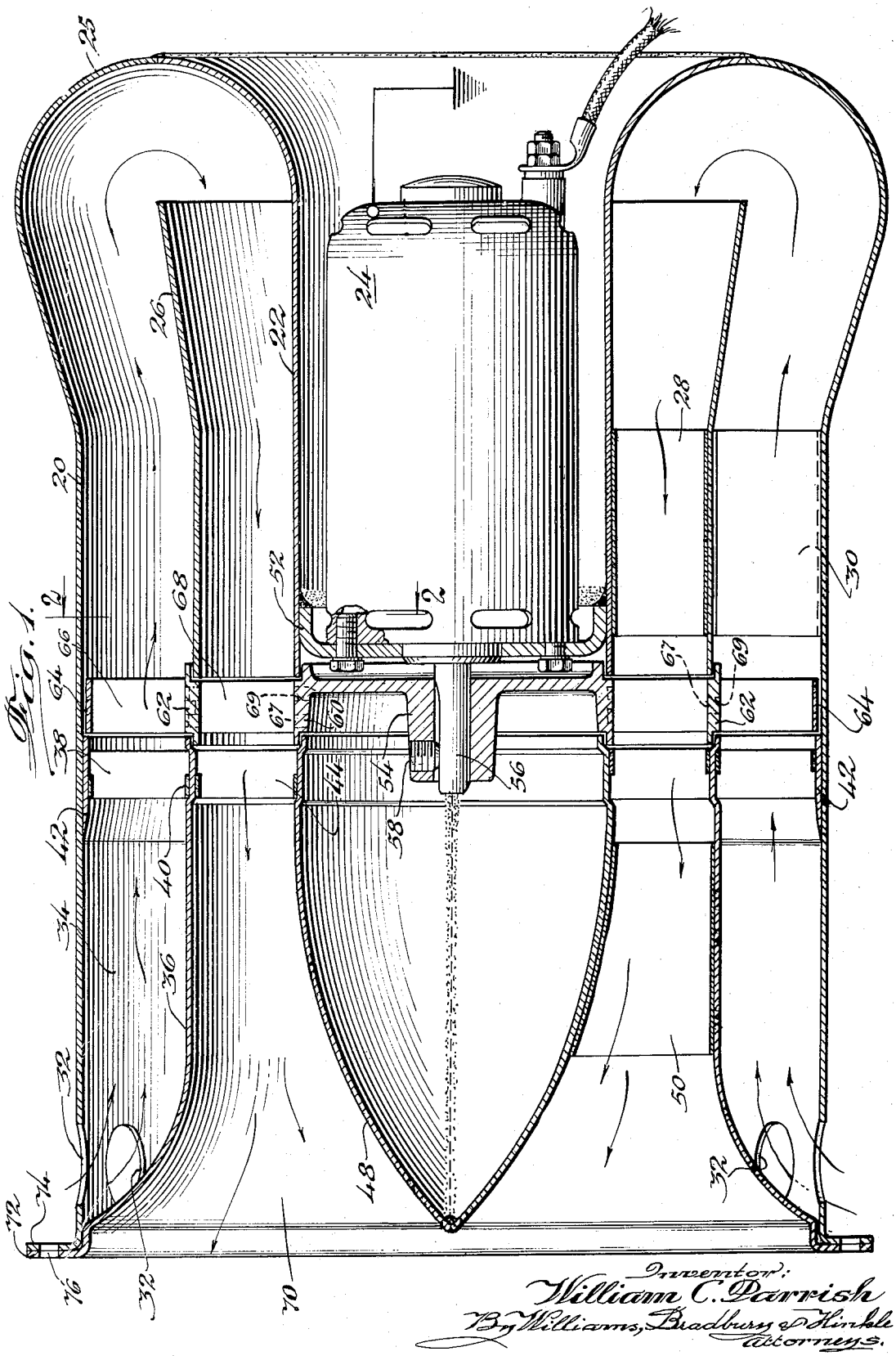


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BLOWER

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Fig. 2.

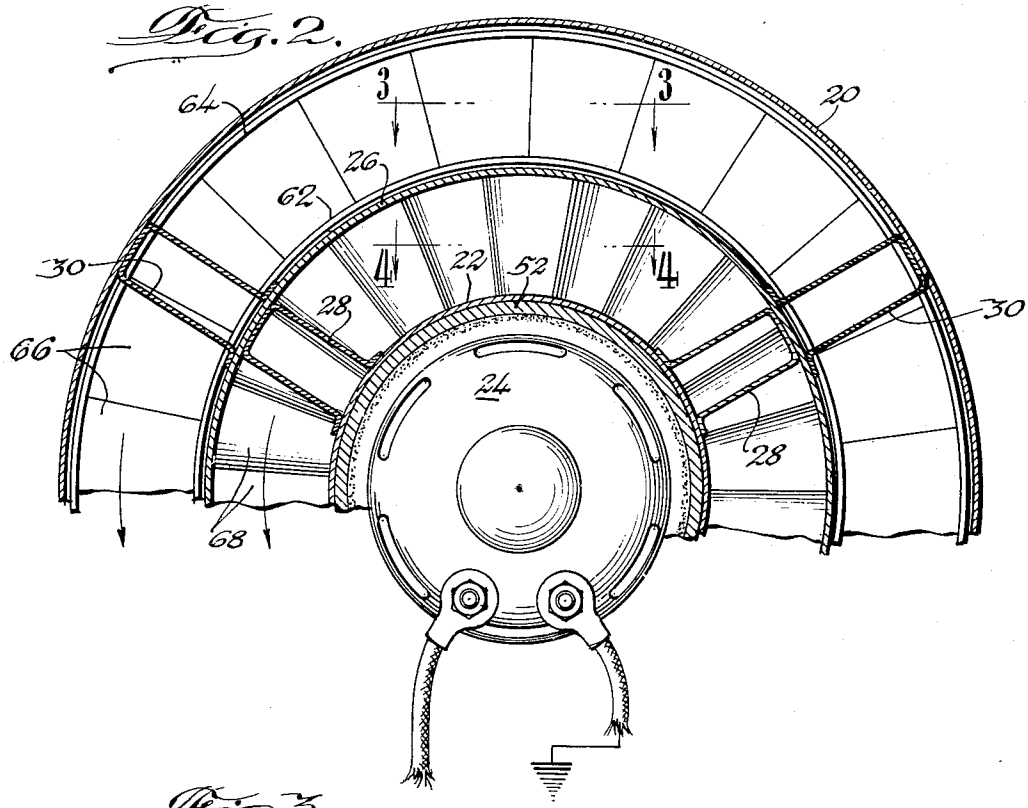
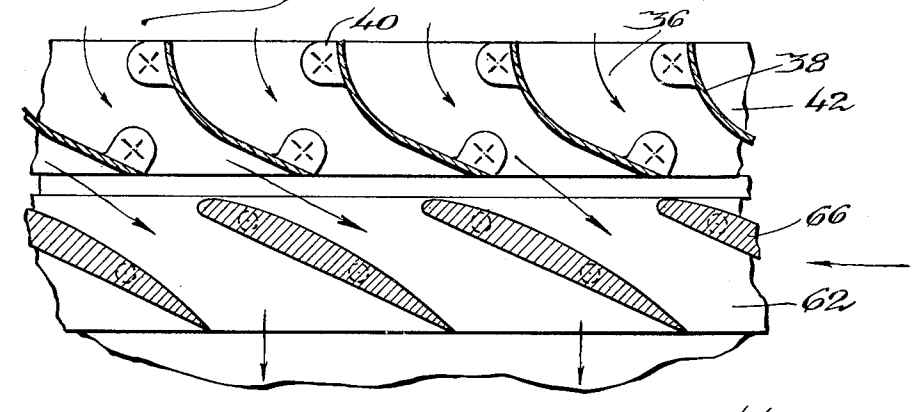



Fig. 3.



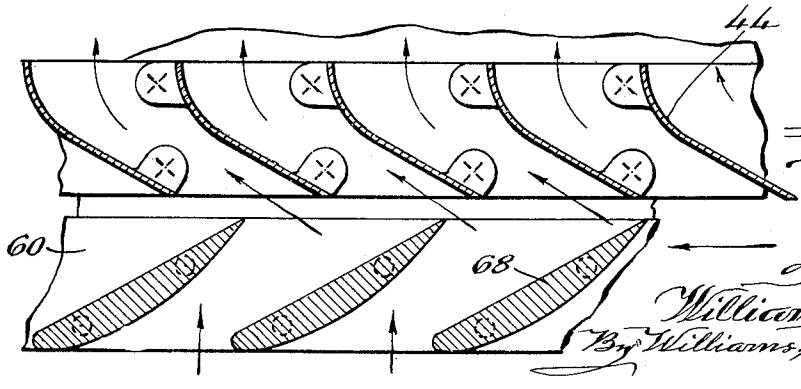




Fig. 4.

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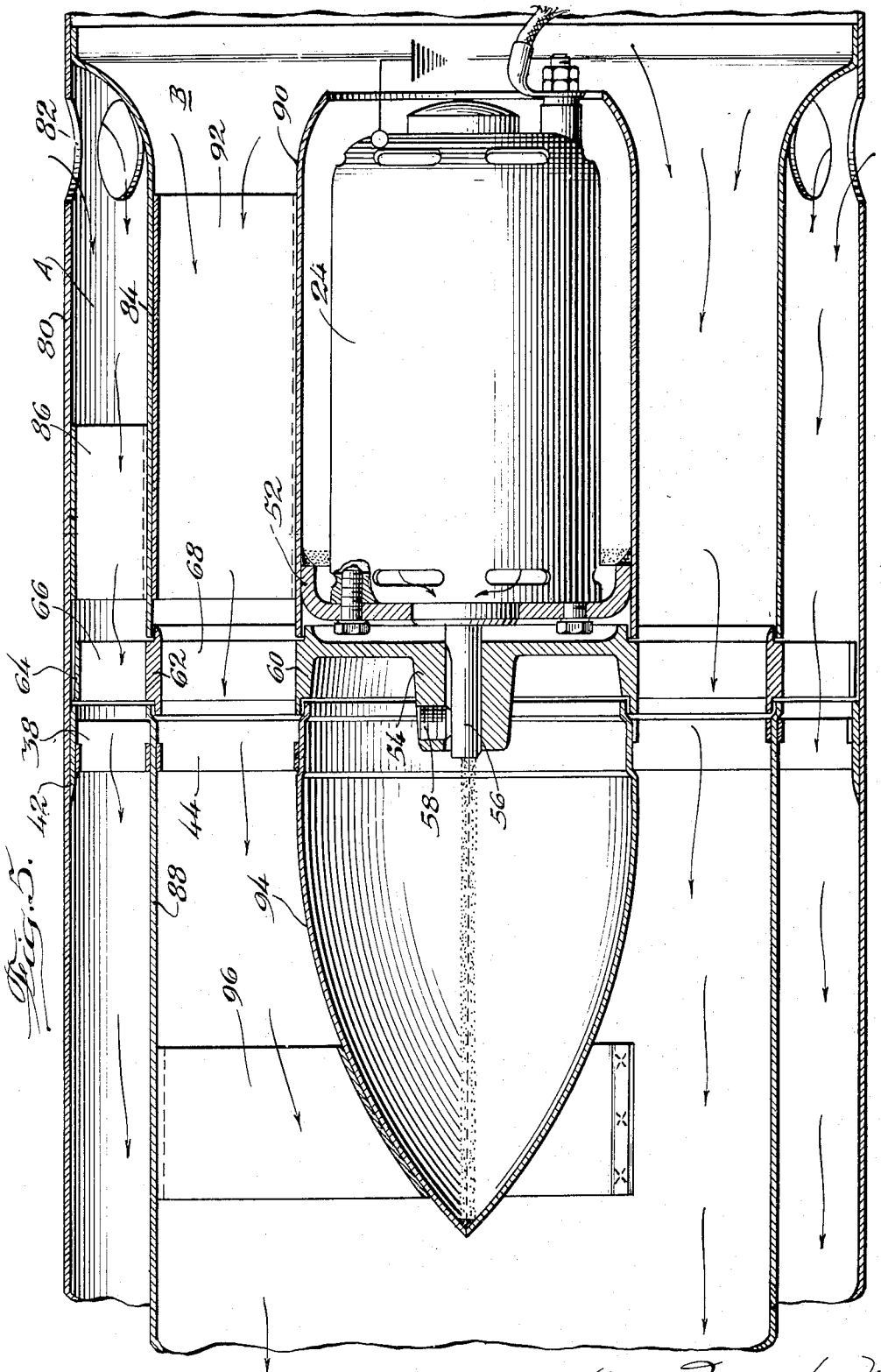


Fig. 5.

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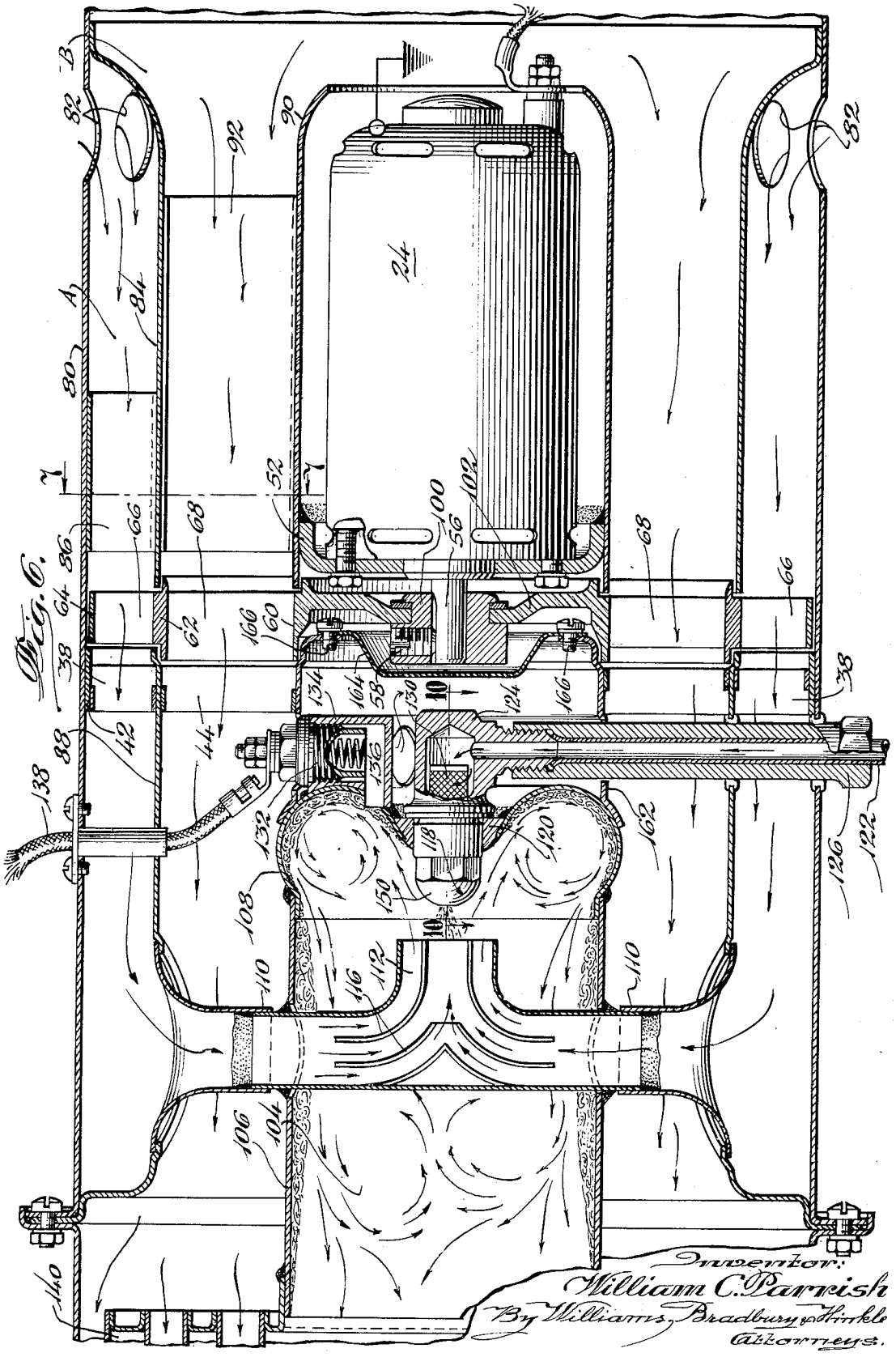

Fig. 6.

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Fig. 7.

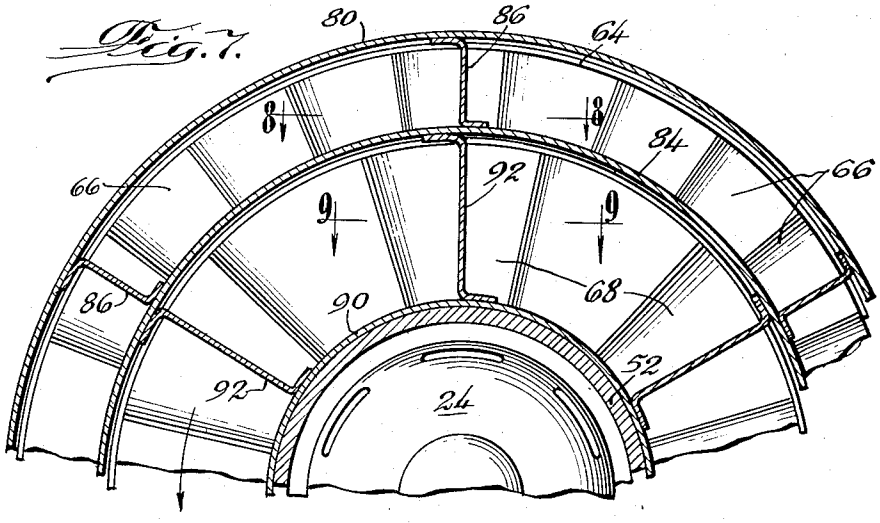



Fig. 8.

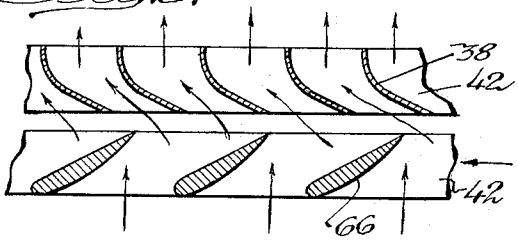



Fig. 9.

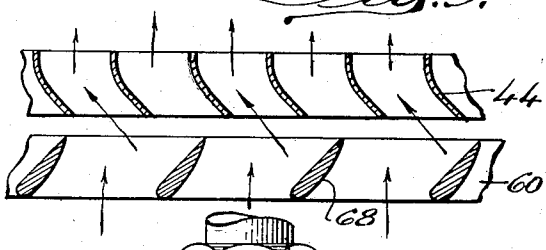
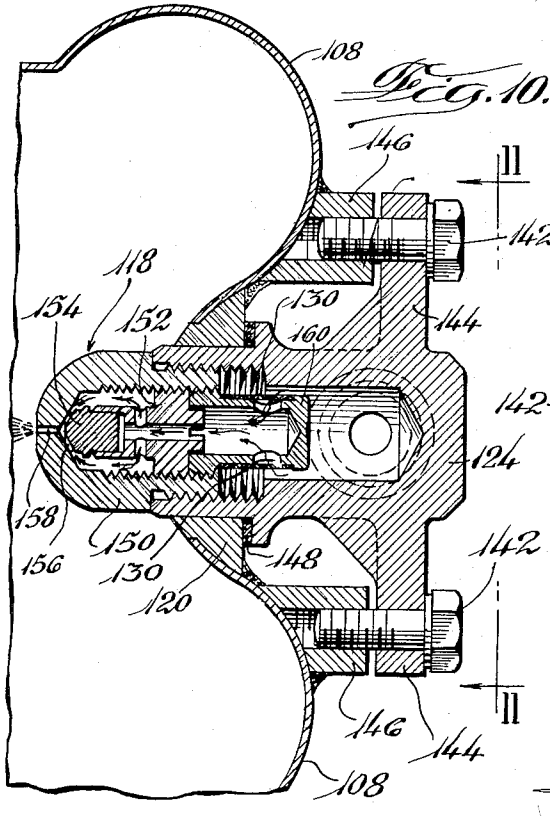



Fig. 10.



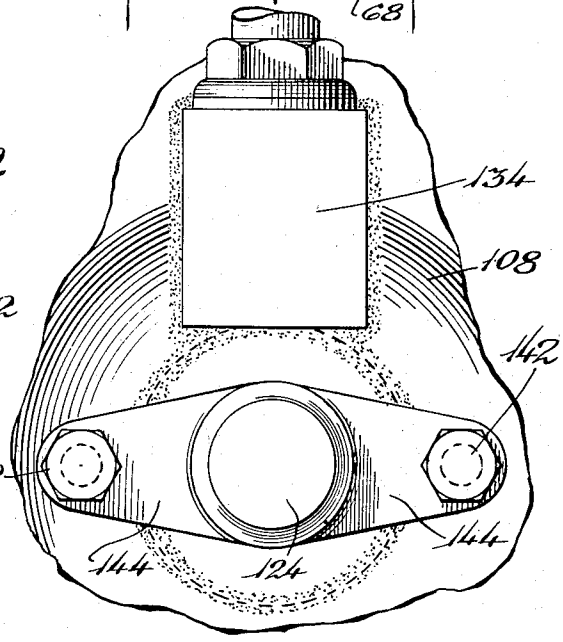




Fig. 11.

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Patented Apr. 9, 1946

2,398,113

# UNITED STATES PATENT OFFICE

2,398,113

## BLOWER

William C. Parrish, Park Ridge, Ill., assignor to Stewart-Warner Corporation, Chicago, Ill., a corporation of Virginia

Application September 10, 1943, Serial No. 501,743

2 Claims. (Cl. 230—117)

My invention relates generally to blowers, and more particularly to multi-stage and dual pressure axial flow blowers.

It is an object of my invention to provide an improved multi-stage or compound blower capable of delivering air under pressure with a high degree of efficiency.

A further object is to provide an improved unitary blower apparatus capable of delivering two separate streams of air at the same or different pressures and rates.

A further object is to provide an improved axial flow blower apparatus for supplying air for combustion and ventilating air to an internal combustion type heater in which the blower rotors are integral, their blades concentric and driven by a common motor.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which

Fig. 1 is a central longitudinal sectional view of a multi-stage blower embodying the invention;

Fig. 2 is a fragmentary transverse sectional view taken on the line 2—2 of Fig. 1;

Figs. 3 and 4 are fragmentary sectional views taken on the lines 3—3 and 4—4 of Fig. 2;

Fig. 5 is a longitudinal sectional view of a dual pressure blower;

Fig. 6 is a longitudinal sectional view of the blower shown in Fig. 5 as forming part of an internal combustion heater;

Fig. 7 is a fragmentary transverse sectional view taken on the line 7—7 of Fig. 6;

Figs. 8 and 9 are fragmentary sectional views taken on the lines 8—8 and 9—9 of Fig. 7;

Fig. 10 is a sectional view of the heater fuel nozzle shown to an enlarged scale, taken on the line 10—10 of Fig. 6; and

Fig. 11 is an end elevational view of the nozzle structure and taken on the line 11—11 of Fig. 10.

The compound or multi-stage blower shown in Figs. 1 to 4 is adapted for use in conjunction with any apparatus in which air under pressure is required at a higher volumetric rate and at a higher pressure than can readily be obtained by fans and blowers of conventional construction. The blower comprises an external casing 20 which is preferably welded to a reentrant tubular internal casing 22 surrounding a driving motor 24. The casings 20 and 22 are formed to provide a streamlined annular bend 25, and the space between the external portion of the casing sheet 20 and the internal casing 22 is separated by a flared generally cylindrical partition 26, the latter being secured in position by a plurality of separators 28 which may be channel-shaped in cross section as shown in Fig. 2, while to secure additional rigidity, similar channel-shaped separators 30 may be secured between the partition 26 and the outer casing wall 20. These separators may be spaced around the casing at 120° intervals, and are preferably spot welded in position.

The outer casing 20 is provided with a plurality of inlet ports 32 for admission of air from the atmosphere or other suitable source, the air entering an annular inlet passage 34 which is formed between the outer casing wall 20 and a bell-mouthed partition 36. A plurality of curved stationary deflector blades 38 are provided with ears 40 by which the blades are respectively welded to a ring 42 and the partition 36. Similar stationary deflector blades 44 are secured between the partition 36 and a streamlined fairing shell 48, the latter being rigidly secured to the partition 36 by a plurality of separators 50.

A motor mounting plate 52 is preferably welded to the internal cylindrical casing 22 and has the motor 24 secured thereto. A rotor hub 54 is secured to the armature shaft 56 of the motor, as by a set screw 58, and has an inner annular flange 60 which forms a broken path or labyrinth air seal between the internal casing portion 22 and the end of the hollow shell 48. The rotor is also provided with a similar outer annular seal band 62 which is recessed to form a broken path air seal between the partitions 26 and 36. The rotor has an annular rim 64 at its periphery. The rotor hub 54 is preferably in the form of a casting, such as a die casting, and has impeller blades 66 set between the rim 64 and the sealing band 62, and similar blades 68 formed between the sealing band 62 and flange 60. Each of the blades 66, 68, has a pair of short dowel-like projections 67 at its inner end and a single such projection at its outer end, for engaging in complementary holes 69 formed in the hub flange 60 and in the bands 62, 64. The bands 62, 64 are sufficiently elastic that they may be sprung over the ends of the blades and thus hold them in assembled relation.

As best shown in Figs. 3 and 4, the rotor blades 66 are of generally airfoil section, overlap each other, and rotate in the direction indicated by the arrow (counterclockwise, Fig. 2), so that the initial helical motion imparted to the air by the blades 38 is utilized to improve the propulsive effect of the blower blades. Similarly, the blades 68 which face in a direction opposite to that of the blades 66 are adapted to impel the air in the

direction indicated by the arrows into passageways 70 between the blades 44 which serve to stop the helical flow imparted by the blades 68 and cause the air to flow longitudinally from the blower through the annular space between the partition 36 and shell 48, this passageway being of annular bell-mouthed shape affording the minimum of resistance to flow of the air impelled by the blower.

The partition sheet 36 is preferably provided with a flange 72 which may be welded to a similar flange 74 formed on the outer casing wall 20, these flanges being provided with suitable bolt holes 76 for facilitating attachment of the blower assembly to the apparatus or duct to which the air under pressure is to be supplied.

In the operation of the blower, air entering the inlet ports 32 is drawn through the annular passageway 34 and given an initial helical direction by the stationary blades 38, and has its pressure increased by the blades 66. The air flowing through the spaces between blades 66 is impelled through the annular passageway formed between the outer casing wall 20 and partition 26, and has its direction of flow reversed by the bend portion 25 of the casing. The air flowing to the left (Fig. 1) through the passageway adjacent the inner casing wall 22 is somewhat above atmospheric pressure, and hence of slightly increased density, thus enabling the blades 68 to operate a little more efficiently in impelling the air through the spaces between the stationary blades 44. The action of the blower is thus compound, in that two stages of compression are employed.

In the modified form of the invention shown in Fig. 5, the blower is adapted to supply two separate streams of air under pressure. The blower comprises an outer substantially cylindrical casing 80 having inlet openings 82, an inlet partition 84 spaced from the casing 80 and secured thereto by separators 86, and a cylindrical outlet partition 88. An inner casing 90 surrounding the motor 24 is spaced from the partition 84 by relatively long separators 92. A fairing shell 94 is secured to the outlet partition 88 by separators 96. The rotor of the blower is constructed in substantially the same manner as above described with reference to Figs. 1 to 4, the only material differences being in the relative lengths of the blades 66 and 68, and that the guide vanes 38 and 44 are both located downstream with respect to the rotor, although with suitable changes in the construction both sets of guide vanes could be located on the upstream side of the rotor. Reference characters corresponding to those of Figs. 1 to 4 have therefore been applied to the similar parts in Fig. 5.

In the operation of the blower shown in Fig. 5, the air stream A entering the inlet ports 82, has its velocity of flow increased by the blades 66 and its tendency toward helical flow retarded by the blades 38. The air stream B entering the space between the partition 84 and inner casing 90 is similarly acted upon by the rotor blades 68, and has its rotary component of velocity substantially removed by the stationary blades 44. The blower may be designed to have the air stream A discharge therefrom at high velocity and pressure while the air stream B may be discharged at a lower pressure and velocity, or vice versa, or the design may be such that the volumetric flow and pressure of the two streams is substantially equal. By virtue of the labyrinth seal effected by the hub 60 and the band 62, there will be but relatively slight leakages from one of the air streams to the other, so that under circumstances where such slight leakage would not be disadvantageous the two streams might be of different gases.

The invention is illustrated by a further modification shown in Figs. 6 to 11, inclusive, in which a blower is illustrated as forming a part of a heater of the hermetically sealed or internal combustion type. The general structure of the blower is similar to that shown in Fig. 5, and corresponding reference characters have therefore been applied to the similar parts. In this embodiment of the invention, the air stream A constitutes the combustion air supply for the heater while the air stream B constitutes the ventilating air supply. The rotor hub in Fig. 6 is illustrated as comprising a bushing 100 to which a flanged member 102 is secured by a peening operation. In other respects the structural details of the blower portion of the heater are the same as in the previously described embodiments.

The heater is illustrated as comprising a combustion chamber 104 formed by a cylindrical wall 106, one end of which is substantially closed by a partly torroidal shaped end wall 108 which may be welded to the cylindrical wall 106. The partition 88 has a pair of openings formed therein to receive the bell-mouthed inlet ends of a pair of fabricated conduits 110 which project diametrically through the cylindrical wall 106 of the combustion chamber and is T-shaped to provide an outlet portion 112. The flow of the air stream A through the conduit 110 to the opening in the axial outlet portion 112 is facilitated by the provision of a plurality of baffles 116.

The opening in the outlet portion 112 is closely adjacent the end of a spray nozzle 118 which is suitably secured in a supporting ring 120, the latter preferably being welded to the end wall 108 at the center thereof. Fuel is supplied to the nozzle 118 through a conduit 122 which is secured to an elbow fitting 124 by means of a clamping fitting 126. The nozzle 118 is detachably secured to the elbow 124, as by threading, and has a fine wire mesh strainer 130 for inhibiting the clogging of the jet orifice in the nozzle 118.

The mixture of fuel supplied through the conduit 122 and air supplied through the ducts 110, is ignited preferably by means of an electrical igniter illustrated as comprising a shell 132 threaded in a fitting 134 which is welded to the end wall 108. The igniter includes a coiled resistance wire 136, one end of which is grounded to the shell 132 and the other end of which is electrically connected to a conductor 138. The products of combustion flow from the combustion chamber to a heat exchanger 140, through the air passageways of which the air stream B is propelled by the blower. The details of construction of a heater of the type generally described are more particularly shown in my copending application, Serial No. 494,155, filed July 10, 1943.

An improved nozzle structure is, however, disclosed in this application, and it is best illustrated in Figs. 10 and 11, wherein it will appear that the elbow fitting 124 is secured to the end wall 108 of the combustion chamber by cap screws 142 extending through lugs 144 formed on the elbow fitting 124, and threaded into sockets 146 which may be welded to the end wall 108. The elbow fitting 124 seals against the ring 120, a suitable gasket 148 being provided to prevent leakage at this point. The nozzle is formed by a tip 150 which is threaded in the elbow fitting

124 and is internally threaded to receive an atomizing plug 152 which has a separate head portion 154 provided with grooves 156 which impart a rotary component of motion to the fuel as it flows toward and outwardly from a jet aperture 158. A fitting 160 supporting the screen 130 is also threaded in the nozzle tip 150. By virtue of this arrangement the nozzle may readily be removed for inspection and any servicing which may be necessary, by unscrewing the cap screws 142.

A protective cap may be provided over the igniter 134 and elbow fitting 124, this cap comprising a generally cylindrical wall 162 which may be welded to the end wall 108 of the combustion chamber, and a cover 164 which is secured in place by a plurality of screws 166, it being understood that access to the cap screws 142 may be obtained by removal of the blower assembly and the removal of the cap 164. To facilitate this removal, it will be understood that the separators 86 may be welded only to the partition 84 and thus may be longitudinally slidable with respect to the outer casing 80.

In operation of the heater, assuming that fuel is being supplied through the conduit 122 at a regulated pressure, and that the igniter 136 and motor are energized, the air stream A will strike the fuel spray formed by the nozzle 118, and some of this fuel will find its way into the fitting 134 where it will be vaporized and ignited, causing ignition of the turbulently flowing mixture of fuel and air adjacent the end wall 108. The burning fuel and products of combustion flow through the combustion chamber 104 into the heat exchanger 140 in which the air stream B is heated. The air stream B also flows around the combustion chamber, deriving heat therefrom, and preventing the cylindrical wall 106 or end wall 108 thereof from becoming overheated.

The heater may be provided with the usual electrical thermostatic controls. It will be clear that assuming that the fuel pressure is well regulated, and that the heater is operating at constant altitude, the fuel air ratio will be maintained relatively constant since the blower operates at constant speed to supply the combustion air stream A to the heater uniformly. Likewise the ratio of combustion air to ventilating air is maintained relatively constant since both of these air streams are derived from a common power source. The heat output of the heater will therefore be relatively constant.

While I have shown and described particular embodiments of my invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of my invention all such variations and modifications by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means.

I claim:

1. A blower comprising an outer cylindrical casing wall and an inner cylindrical casing wall, said walls being joined at one end to form a 180° bend, a cylindrical partition held in spaced relation between said casing walls, said casing walls and partition providing a substantially continuous passageway, a motor secured within the inner casing wall, a rotor driven by said motor, said rotor having two sets of impeller blades of opposite pitch, one of said sets rotating across the outer portion of said passageway and operating to impel air in one direction, the other set of blades rotating across the inner portion of said passageway and impelling air therethrough in the opposite direction, said rotor having a hub forming substantially a continuation of the inner casing wall, an annular ring secured to said hub by the inner set of blades and forming substantially a continuation of the cylindrical partition, and an outer band surrounding the outer set of blades and acting as a support therefor.

2. In a blower structure, the combination of a motor, an inner cylindrical casing wall surrounding said motor, a cylindrical outer casing wall, a cylindrical partition located intermediate said casing walls, a rotor driven by said motor, said rotor having a hub portion having a generally cylindrical surface of substantially the same diameter as said inner casing wall, a band of substantially the same diameter as said partition, a plurality of impeller blades secured between said band and said rotor hub, and a plurality of impeller blades projecting outwardly from said band so as to impel air through the passageway formed between the outer casing and the partition.

WILLIAM C. PARRISH.