ABSTRACT: An electric vacuum cleaner with a "turbine-type" suction pump wherein an integrally molded member forms a substantial part of the pump chamber and the electric motor housing.
ELECTRIC VACUUM CLEANER WITH TURBINE-TYPE SUCTION PUMP

BACKGROUND OF THE INVENTION

This invention relates to a vacuum cleaner, and more particularly, to an improved suction pump and electric motor construction for a vacuum cleaner.

In the manufacture of vacuum cleaners, it has been customary to employ centrifugal or radial flow pumps to provide the necessary suction. Air is introduced to a centrifugal pump through an inlet disposed centrally of the impeller. It is thereafter engaged by the impeller, hurled outwardly and generally in the direction of impeller rotation by centrifugal force, and exhausted through a centrifugal outlet.

"Turbine-type" pumps and "Vortex" pumps have been used industrially for many years in operations where high head and moderate flow of liquids are required. In such a pump, fluid is generally introduced at some distance from the center of the impeller. The fluid is thereafter engaged by the impeller vanes, undergoes a centrifugal push toward the periphery of an annular channel encompassing the outer extremities of the impeller vanes, and is then recirculated toward the root of the vanes. This recirculation which is repeated as the fluid passes around the pump body imparts ever increasing energy to the fluid being pumped to thereby increase static pressure. In comparison to a centrifugal pump of similar size, a "turbine-type" pump will develop a greater static head pressure.

It is an object of this invention to use such a "turbine-type" pump in an electric vacuum cleaner to pump air, as contrasted with liquid, and to function principally as a source of vacuum or suction, as contrasted with outlet static head pressure. Such "turbine-type" pumps have been found to be efficient, and to have high vacuum power, however, one problem which has been encountered in the use of such a "turbine-type" pump is that it delivers an objectionable exhaust blast of air.

It is therefore, also an object of my invention to incorporate a "turbine-type" suction pump in a vacuum cleaner to obtain all of the advantages of a "turbine pump" while solving some of the problems inherent in the use of such a suction pump.

It is a further object of this invention to provide a combined "turbine pump" and electric motor construction which utilizes a minimum number of parts which may be readily manufactured and assembled to each other.

SUMMARY OF THE INVENTION

In accordance with one of the aspects of this invention, an integrally molded member forms a substantial part of an annular pump chamber and an electric motor housing. A partition is integrally molded with the member and is positioned between the pump chamber and the electric motor housing. An impeller, including a hub portion and a plurality of radially extending blades is mounted for rotation within the pump chamber. The annular pump chamber includes an enlarged air inlet chamber for permitting inlet air to freely flow to the impeller, and an air-accelerating chamber adjacent to the air inlet chamber for producing a spiral air flow within the pump chamber to thereby generate a high static head pressure and a corresponding high vacuum in the enlarged air inlet chamber. A diffusing chamber having an enlarged exhaust opening is integrally molded with the annular pump chamber for reducing the force of the exhaust blast of air.

With this construction, a "turbine-type" suction pump is uniquely combined with an electric motor using a minimum number of parts and the exhaust blast of air from the pump is minimized. Thus an exceedingly simple, compact, and high performance suction pump and electric motor construction for a vacuum cleaner has been achieved.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and attendant advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a perspective view of an electric vacuum cleaner construction embodying my improved electric motor and suction pump;

FIG. 2 is a fragmentary cross-sectional view of the lower portion of the vacuum cleaner shown in FIG. 1, some of the parts being broken away to show details of construction;

FIG. 3 is a fragmentary rear elevational view of the vacuum cleaner shown in FIG. 1, some of the parts being broken away to show details of construction;

FIG. 4 is a fragmentary cross-sectional view taken along the line 4-4 in FIG. 2;

FIG. 5 is a fragmentary cross-sectional view of my unique suction pump and electric motor construction;

FIG. 6 is a fragmentary cross-sectional view taken along the line 6-6 of FIG. 4;

FIG. 7 is a fragmentary cross-sectional view taken along the line 7-7 of FIG. 6;

FIG. 8 is a fragmentary cross-sectional view of my improved suction pump construction illustrating the air flow within the pump chamber;

FIG. 9 is a perspective view of my improved molded member showing the pump chamber;

FIG. 10 is a perspective view of the molded member showing the electric motor housing; and

FIG. 11 is a fragmentary perspective view of the impeller of my improved suction pump.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a vacuum cleaner generally designated by the reference numeral 10 embodying my improved electric motor and suction pump construction. As shown, a handle 12 is pivotally mounted to the vacuum cleaner for moving the vacuum cleaner back and forth over a floor to be cleaned. The cleaner includes a casing 14 having generally vertical front, rear and side panels 16, 18, 20 and 22 respectively, and a generally horizontal bottom wall 24. As shown in FIG. 2, my unique motor fan unit 24 is positioned in side of the casing for causing air to flow through an enlarged generally rectangular suction air inlet opening 26 through a filter bag 28, through the motor fan unit 24, and to exhaust from the casing as shown by the arrows.

As shown in FIG. 2, a brush 30 may be mounted in the suction air inlet opening 26, so as to be in contact with the surface of a floor to be cleaned. An endless belt 32 is provided for connecting the motor fan unit 24 with the brush 30 in order to drive the brush.

As shown more particularly in FIG. 4, the motor fan unit 24 includes an electric motor 25 which may be of the alternating current series-wound type with an armature 36, a commutator 38, and brushes 40 to provide the connection across a source of power for the commutator and the armature. An output shaft 42 is connected to the armature 36 so as to rotate therewith, and a pump impeller member 44 is secured to the shaft. As shown, one end of the shaft 42 also extends through the pump housing for driving belt 32 which rotates brush 30.

In accordance with my invention, a "turbine-type" pump 44 is uniquely incorporated in a vacuum cleaner and combined with the electric motor 25 in order to achieve a construction which utilizes a minimum number of parts which may be readily manufactured and assembled to each other.

As shown more particularly in FIG. 9, the most significant part of the unique electric motor and suction pump arrangement is an integrally molded member 46 which is provided for forming a substantial portion of a generally annular pump chamber 48 and an electric motor housing 50. The member 46 is preferably formed from "Lexan" or other plastic which may be readily molded with a plurality of projections extending inwardly and outwardly from a main body portion of the mold.
With reference to FIGS. 4, 9, and 11, it can be seen that the pump chamber 48 may be uniquely formed at one side of the molded member 46. As shown in FIG. 10, the pump chamber 48 is integrally molded with member 46. As shown more particularly in FIG. 4, a partition 52 integrally molded with member 46 separates the pump chamber 48 from the electric motor housing 50 and a generally cylindrical bearing holder 54 extends axially inwardly for forming a radially inner wall 55 of the pump cavity. A cover 56 is shown for receiving a shaft 42. The bearing is shown more clearly in FIG. 4, and as illustrated, it may be retained within the cylindrical holder 54 by a snap ring 58 or other suitable securing means.

As shown more particularly in FIG. 10, the other side of the integrally molded member 46 forms a substantial part of the housing for electric motor 25. Upper and lower commutator brush receiving housings 60 and 62 are integrally molded with the member for receiving and supporting commutator brushes 40. As shown, the brush housings 60 and 62 extend outwardly from the bearing holder 54 and are integrally connected to the central partition 52 and an outer wall 64 of the electric motor housing 50. As illustrated, the outer wall 64 of the electric motor housing is generally cylindrical in shape in order to accommodate the electric motor 24.

As shown more particularly in FIGS. 5 and 10, my uniquely formed member 46 also includes an integrally formed air receiver 66 for receiving and supporting a switch 68 for the electric motor 24. Switch 68 includes a casing 70 which is positioned between the switch chamber 66 and an actuating knob 72 which extends through an opening 74 formed in an outer wall 67 of the switch chamber 66. As illustrated more particularly in FIG. 5, suitable electrical leads 76 are located within the switch chamber 66 and extend from switch 68 to the commutator brushes 40 of the electric motor 25. By this arrangement, the switch 68 for the vacuum cleaner may be readily and conveniently supported on the integrally formed member 46 in close proximity to the electric motor brushes 40.

As shown more particularly in FIG. 4, a cover 80 which is preferably formed of metal or other suitable material is provided for enclosing the left end of motor 25. Suitable slots 82 are formed in the cover 80 for allowing coolant air to flow through the motor. As shown more particularly in FIG. 10, protruding bosses 84 extend outwardly from the integrally molded member 46 for cooperating with apertures 86 which may be formed in the sheet metal cover 80 in order to conveniently align and connect cover 80 to the motor housing 64. In addition, screw-receiving lugs 85 may be integrally formed with my unique molded housing member 50 for receiving screws or other suitable connecting means for securing the sheet metal cover 80 to the motor housing 50. As illustrated in FIG. 4, a suitably positioned filter 87 may be slipped over sheet metal cover 80 for filtering the air before it passes through slots 82.

My unique turbine-type pump construction will now be more particularly described. As shown in FIGS. 4 and 11, the pump includes an impeller 88 having a hub portion 90, a radially extending disc 92 centrally disposed on the hub 90, a first set of blades 94 extending from one side of the disc 92, and a second set of blades 96 extending from the other side of the disc 92. As shown in FIG. 11, the first set of blades 94 on one side of disc 92 are alternately arranged with respect to the blades 96 extending from the other side of the disc.

The impeller is preferably formed of nylon or other suitable material which is capable of withstanding high centrifugal forces developed in the impeller. The impeller hub 90 includes a generally cylindrical bore 100 for receiving shaft 42, and as illustrated, the impeller hub is secured to the shaft 42 by means of a washer and nut assembly 102.

With particular reference to FIGS. 8, 9, and 4, it can be appreciated that the pump chamber 48 is formed with the molded member is contoured in the general form of an annulus. As shown in FIG. 4, the integrally molded pump chamber 48 extends to the right in an axial direction beyond the axial extremity of the blades 94. Thus, in order to complete the pump cavity for blades 94 and to otherwise cooperate with the integrally molded pump chamber member 48 a molded cover 104 is secured to the right side of the integrally molded pump chamber 48. As illustrated in FIG. 4, the pump cover 104 is contoured on its inner face 106 to define a portion of the annular pump cavity. The cover is preferably formed of styrene plastic or other suitable material which may be readily molded to the shape illustrated. Screw-receiving lugs are integrally formed in the cover for cooperating with corresponding screw-receiving lugs 108 formed in the molded pump chamber 48 for suitably connecting the cover 104 to the pump chamber by means of screws 110.

With particular reference to FIG. 9, it can be seen that an enlarged air inlet opening 112 is formed in partition 52. With this arrangement, the air entrance to the pump chamber 48 is positioned so as to draw in air to cool the motor and to give proper entry of the air to the turbine-type pump impeller 88. As illustrated by the arrows in FIG. 4, cooling air flows through slots 82 across the armature 36, over brushes 40 and commutator 38 and then through air inlet opening 112 to the pump chamber 48. As shown in FIGS. 2 and 7, an air inlet opening 114 may also be provided within the pump cover member 104 in order to provide additional inlet air to the pump chamber 48, however, it can be appreciated that should it be desired to have all of the inlet air flow over the motor in order to cool the motor, the inlet opening 114 in the pump cover 104 may be dispensed with. As illustrated more particularly in FIGS. 2 and 7, the air inlet opening 114 in the pump cover 104 is disposed generally opposite to the air inlet opening 112 in partition 52. Thus, air inlet from either one of the openings 112 or 114 enters the pump chamber at the same circumferential position within the pump chamber.

With particular reference to FIGS. 6, 7, and 9, it can be seen that the pump chamber 48 includes a relatively large air inlet chamber 116 which permits inlet air to flow to both vanes 94 and 96 from opening 112 or both opening 112 and opening 114 as indicated by the arrows in FIG. 7. After passing through the air inlet chamber 116, air is circulated within the pump cavity 48 in an adjacent air-accelerating chamber 118. As illustrated more particularly in FIGS. 6 and 8, it can be appreciated that the cross-sectional area of the air-accelerating chamber 118 is substantially constant and is substantially less than the cross-sectional area in the air inlet chamber 116. The tips of blades 94 and 96 are positioned closely adjacent to the walls of the air-accelerating chamber, and the impeller width and diameter are related to the free air space within the air-accelerating chamber so that air is thrown outwardly against the walls of the pump cavity and is readily circulated back to the root of the blades with increasing force as it moves from the air inlet chamber 116 to the vicinity of a baffle wall 120.

As shown more particularly in FIG. 6, baffle wall 120 functions as a cutoff to effectively separate the air inlet and discharge portions of the air pump, thereby preventing recirculation of the air except for the relatively small space between two or three adjacent vanes 94 and 96. As illustrated more particularly in FIGS. 9 and 3, a substantial portion of the baffle wall 120 is integrally formed with the molded member 46 which also forms the annular pump chamber 48. The remaining portion of the baffle wall 120 is formed in the integrally molded cover 104.

With particular reference to FIG. 6, it can be appreciated that the baffle wall 120 cooperates with an extension 122 of the radially outer wall of the air inlet opening cover 112 to provide a diffuser chamber 123 of ever increasing cross-sectional area. In order to obtain maximum efficiency, the relatively flat baffle wall 120 is arranged generally tangent to the impeller wheel 88 at the point where it is most closely adjacent to the tips of the impeller blades, that is, at the cutoff point.
addition for maximum efficiency, the radially outer wall 122 of the diffuser chamber 123 is smoothly integrally connected to the outer wall 119 of the air-accelerating chamber 118 and is of equal radius radius.

While the diffusing chamber 123 substantially reduces the exhaust blast of air from the turbine pump, the air exiting from the enlarged opening 124 of the diffuser 123 is not directional that the air blast from the unit would carry beyond 6 feet. Accordingly, should the air blast be directed in the vicinity of the handle 12 of the vacuum cleaner, the exhaust blast could be felt by an operator of the vacuum cleaner, and thus be objectionable. With particular reference to Fig. 3, it can be seen that the enlarged exhaust opening 124 is positioned adjacent to the generally vertical rear wall 18 of the vacuum cleaner, thus it is necessary to provide an enlarged opening 126 in the vacuum cleaner casing wall 18 so that the air may flow relatively unimpeded to the atmosphere. However, in order to direct the air blast away from the user, a plurality of louvers 128 are preferably formed in opening 126. As illustrated the louvers are positioned at an angle to direct the exhaust blast of air to the left as shown in Fig. 3. As shown more particularly in Fig. 3, it can be seen that the exhaust opening 120 from the diffuser 123 is positioned closely adjacent to the switch-actuating knob 72. By this arrangement, an aperture 130 for receiving knob 72 may be conveniently stamped in the generally vertical rear wall 18 of the vacuum cleaner at the same time that the air exhaust opening 126 and louvers 123 are being formed.

From the foregoing description it will be appreciated that with my unique construction a highly efficient turbine-type pump has been incorporated in a vacuum cleaner with the use of a minimum number of parts which may be readily manufactured and assembled to each other. It can be seen that the principle part of this unique combination is an integrally molded member 46 which is formed to include a number of different portions which provide a plurality of functions. The molded member 46 includes a substantial part of an annular pump chamber 50, and a substantial part of an electric motor housing 50. Brush receiving housings 60 are integrally molded in the member along with a generally cylindrical holder 112 for the shaft bearing, and a switch chamber 66. In addition, a number of screw-receiving lugs 108, 85 and bosses 84 are integrally formed in the molded member 46 so that other portions of the electric motor and fan may be readily connected to the molded member 46. It can also be appreciated that my unique electric motor and turbine-type suction pump for a vacuum cleaner includes an integrally formed divergent chamber 123 for improving the efficiency of the suction pump while reducing the force of the exhaust blast of air. In addition, louvers 128 may be readily formed in the rear wall of the vacuum cleaner casing for directing the exhaust blast of air away from the user. This is accomplished without substantially impeding the flow of air from the vacuum cleaner casing or the efficiency of the turbine-type suction pump.

What I claim is:

1. An electric motor and suction pump for a vacuum cleaner comprising:
   a. an integrally molded member forming a substantial part of an annular pump chamber and an electric motor housing;
   b. a partition integrally molded with said member positioned between said pump chamber and said electric motor housing;
   c. an impeller mounted for rotation within said pump chamber, said impeller including a hub portion and a plurality of radially extending blades;
   d. said annular pump chamber including an enlarged air inlet chamber for permitting inlet air to freely flow to both sides of said impeller and an air-accelerating chamber adjacent to said air inlet chamber for producing two general spiral air paths; and

2. An electric motor and suction pump for a vacuum cleaner as in claim 1 wherein said motor is operated with a vacuum motor pump chamber.

3. An electric motor and suction pump for a vacuum cleaner as in claim 2 wherein said motor is operated with a vacuum motor pump chamber.

4. An electric motor and suction pump for a vacuum cleaner as in claim 3 wherein said motor is operated with a vacuum motor pump chamber.

5. An electric motor and suction pump for a vacuum cleaner as in claim 4 wherein said motor is operated with a vacuum motor pump chamber.

6. An electric motor and suction pump for a vacuum cleaner as in claim 5 wherein said motor is operated with a vacuum motor pump chamber.

7. An electric motor and suction pump for a vacuum cleaner as in claim 6 wherein said motor is operated with a vacuum motor pump chamber.

8. An electric motor and suction pump for a vacuum cleaner as in claim 7 wherein said motor is operated with a vacuum motor pump chamber.

9. An electric motor and suction pump for a vacuum cleaner as in claim 8 wherein said motor is operated with a vacuum motor pump chamber.

10. An electric motor and suction pump for a vacuum cleaner as in claim 9 wherein said motor is operated with a vacuum motor pump chamber.

11. An electric motor and suction pump for a vacuum cleaner as in claim 10 wherein said motor is operated with a vacuum motor pump chamber.

12. A vacuum cleaner including an electric motor and suction pump as in claim 11 wherein said motor is operated with a vacuum motor pump chamber.

13. An electric motor and suction pump for a vacuum cleaner as in claim 12 wherein said motor is operated with a vacuum motor pump chamber.