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FLUID MOVING SYSTEM AND AN ELECTRIC MOTOR-PUMP UNIT THEREFOR

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FIG. 1

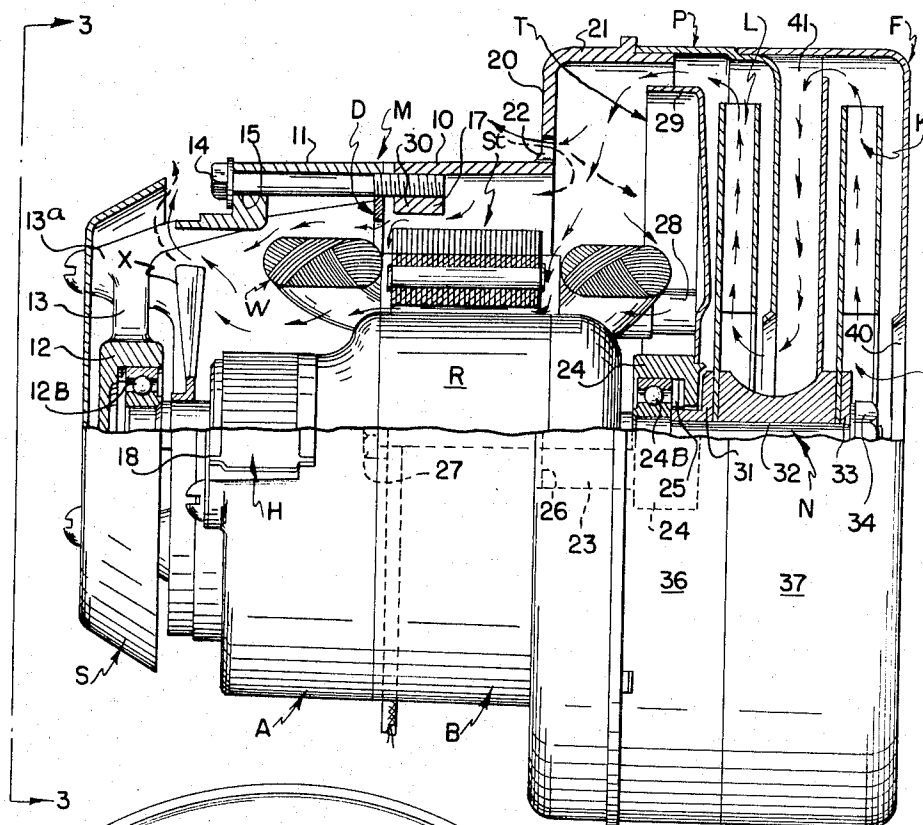


FIG. 3

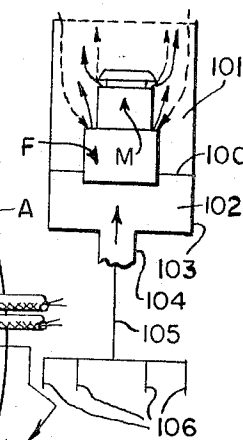
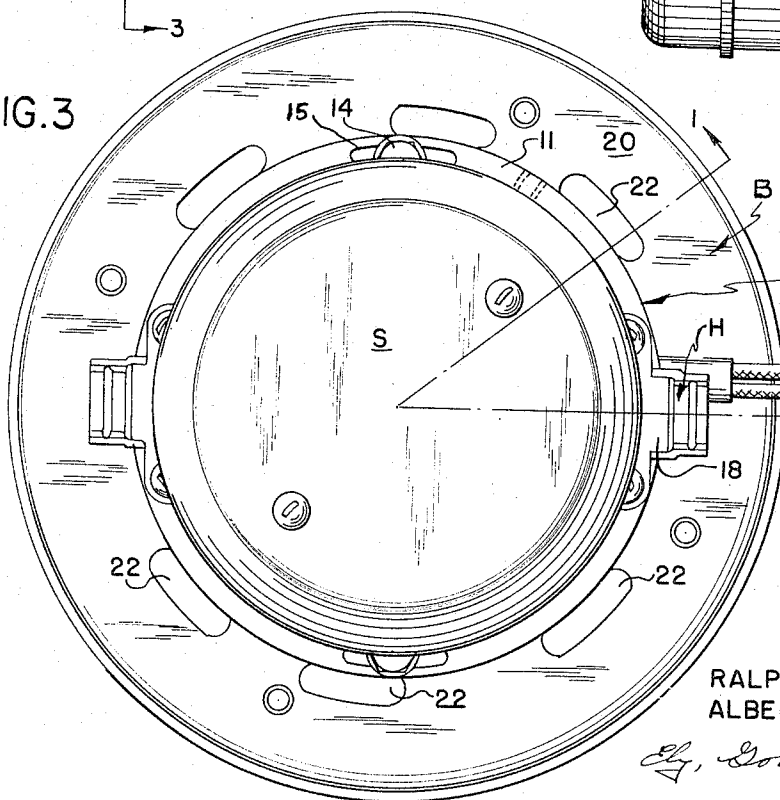


FIG. 2

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FLUID MOVING SYSTEM AND AN ELECTRIC MOTOR-PUMP UNIT THEREFOR

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4 Claims. (Cl. 230-117)

The present invention relates generally to a fluid moving system including a motor-powered centrifugal pump and more particularly to improvements in a motor-pump unit providing for cooling of the motor in the event that a main fluid stream or intake stream to the pump is blocked or substantially impeded. One aspect of the invention, moreover, is directed to simplicity of structure in a motor-fan unit for such a gaseous-fluid system and to providing certain structure adapted for use either in a unit wherein the motor is normally cooled at least in part by at least a portion of the fluid moved by the pump, or in separately ventilated units for like environments, so that certain basic structure may be produced for incorporation in either type of unit.

Since the invention arose out of endeavors to solve certain problems and to meet certain requirements for built-in vacuum cleaning systems in residential buildings, and since the invention has particular advantages in such an environment, it is hereinafter discussed and disclosed in terms of a vacuum-producing electric motor-fan unit for vacuum cleaners or vacuum cleaning systems wherein air is the moved fluid rather than in terms of a liquid.

Such built-in vacuum cleaning systems comprise at an acceptable out of the way location a dirt collecting means and a vacuum-producing unit, now almost universally electrically driven, the air intake of which is connected by built-in piping to usually several cleaning hose connection fittings about the building, each of which is normally closed until a hose is connected for cleaning purposes. For such a system, there is concern about the possibility that the electric motor of the vacuum unit may be left turned on for an extended period. In the case of units where the motor cooling is dependent on cleaning air flow, if this occurs with the intake of air to the vacuum fan is blocked or greatly impeded, no air or an insufficient amount is discharged to prevent with certainty a motor temperature rise which is unsafe, objectionable or unacceptable to inspection agencies or rating groups such as Underwriters Laboratories.

Because of their compactness, electric motor fan units wherein the cleaning air stream discharges from a vacuum-producing fan section through and/or around a motor section of the unit as a normal and primary motor cooling means in normal operation are widely produced and used, for example, in portable vacuum cleaners of one type or another; as efficient, high performance, rugged yet relatively low cost designs for such units have been developed and are commercially available.

By the present invention there is provided an improvement in motor-fan units and therefore in systems embodying the same in which a suction or vacuum air stream, i.e., a main cleaning air stream, normally provides motor cooling, but incorporating second motor cooling means including a distinct fan and air movement, whereby a main object of ensuring sufficient motor cooling is obtained, and this with relatively minor change in the physical size and basic structure of proven motor-fan units. Another object of the invention is to provide a motor-fan unit of the type described with relatively low increase in cost for the improvement obtained. Other objects and advantages will appear from the following description, and the drawings wherein:

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FIG. 1 shows in detail and in partial longitudinal section a motor-fan unit for carrying out the present invention;

FIG. 2 shows schematically the placement of the unit in one environment, in accordance with the present invention;

FIG. 3 is a motor-end end-view of the unit itself.

The motor-fan unit of the drawing comprises (see FIGS. 1 and 2) the motor section M and fan section F, the unit being incorporated in an air transporting flow system, by a mounting 100 acting as a part of a wall or partition dividing the system into a discharge or atmospheric pressure side 101 and a vacuum side 102, in the schematically represented unit enclosure 103. For example, the space 102 between the enclosure inlet 104 and the fan section may be occupied by a dirt collecting cleaning air filter bag to capture dirt borne in air drawn to 104 connected to piping 105 serving hose connecting ports 106 in a residence cleaning system or connected more or less directly to a hose, where the unit is incorporated in a portable electric vacuum cleaner.

The motor section M includes as principal components or sub-assemblies, first the commutator end bracket A and fan end bracket B as main motor frame elements rotatably mounting, through anti-friction or other suitable bearings 12B, 24B, a rotor or armature R coaxially disposed in a motor field or stator structure S, ventilating air directing baffle plate D, and brush holder units H supported in the end bracket A. The fan section F, a two stage fan arrangement includes the first and second stage centrifugal impellers K, L clamped in axially spaced relation on the motor shaft N, a two-stage fan shell sub-assembly or housing P, and also a second stage fan chamber end baffle and shroud member T.

The member A integrally includes an internally rabbeted generally cylindrical body portion 11 fitted on the end of the generally cylindrical body portion 10 of bracket B, and a preferably cooling-finned bearing socket 12 offset from the body on bridging spider arms 13. Diametrically paired clamp bolts 14 through coaxially arcuately slotted rim formations at 15, threaded into inward bosses 17 on body portion 10 secure the members A and B as a motor frame, permitting limited angular position adjustment, relative to the field, of the brush holders H each secured in integral diametric seat formations on member A, by a respective holder clamping member 18.

An auxiliary fan X is press-fitted or otherwise secured on the shaft between the commutator and the anti-friction bearing unit 12B and a shield member S of shallow dish form, for example, a sheet metal disc with inwardly sloped or conical rim, bolted to spider bosses 13a on member A, is spaced from the bearing socket, spider arms 13 and rim 11 to define an outlet for motor cooling air discharging from the auxiliary fan operating space.

In the second primary frame member B, the fanward end of body portion 10 through radial flange 20 is integrally joined to a short cylindrical rim 21 on which is telescoped a second stage portion of the sheet metal fan housing P secured thereon by any suitable means. A plurality of angularly spaced circumferentially directed arcuate slots 22 through wall 20 here immediately adjacent the body portion 10 serve as air ports as later described.

The opening of the end enlargement thus formed in member B is spanned by a generally diametrically extended integral spider formation 23 having at its center the bearing socket 24 for the bearing 24B, and a pair of spaced stator stack seating bosses as 26 into which are threaded respective field mounting screws 27 running lengthwise through the stator core or field stack of laminations. On reduced ends of angularly spaced posts 28 integrally projecting fanwards from wall 20, the cen-

tral disc-like portion of the shallow drawn sheet metal end baffle and shroud member T is retained by hot staking or forming the post ends projecting through the disc in a rivet-like manner. The short rim flange 29 of the member T provides a shroud formation in spaced relation within the rim 21 defining therewith a discharge air diffusing and guiding passageway from the second stage fan housing. With units 12B, 24B ball bearing units, for each the inner race is lightly pressed onto the motor shaft N against a shaft shoulder and lubricating spacing and spring biasing washers generally designated as 25 are located between the respective socket bottom and outer race, so that the units have a degree of axial "float" therein.

With a lamination stack of generally square external outline with rounded corners, however, to fit within the body 10, pairs of circumferentially spaced integral inward lugs 30 on the left end of wall or body portion 23 embrace loosely respective corners as a means locating the stack in angular sense. The air deflecting ring or baffle plate D can be held in exact position angularly by bolts 14 and axially by surfaces lying within rabbeted fitted portions of member A and on the end of the member B. A large center opening in the member D defines the periphery of the space available for air discharge from the field region, that is, passing axially in the longitudinal spaces defined between the body portion 10 and the flat sides of the stator. The field windings W extend axially outward beyond the member D shaped to accommodate the same the location of D causing air to flow not only over the end turn portions of the windings W, but also inwardly between the end of the windings and the adjacent field to pass under the interior or inward surfaces and thereafter over the commutator for discharge through the open regions of the member A under end shield S. Preferably the effective width of the annular plate D is greater at locations 90 degrees from the coils to direct the actual air flow more sharply inwardly over the end of the rotor and commutator towards the brush and brush holder regions.

In the fan section structure otherwise is rather conventional, e.g. with two sheet metal type impellers L, M clamped on the projecting shaft N by a flanged spacer sleeve 31 abutting the inner race of the bearing 24B, a spacer spool 32 between the apertured central impeller regions, a washer 33, and thereagainst a clamping nut 34 on the threaded shaft end.

In the two-stage housing P formed of two similar drawn sheet metal cup-shaped members 36, 37, member 37 having a central primary unit air inlet opening 40 in its radial end wall and telescoped upon 36, and this in turn telescoped on rim 21, a main stream of cleaning air enters through inlet 40 into impeller K, discharging from which peripherally it passes inwardly in passages defined between the second stage shell radial wall, a set of angularly spaced air guide vanes 41 and disc 42 mounted thereon with periphery spaced from the cylindrical wall portion of the member 37, to enter the impeller L through a central second stage inlet opening in the end wall 36. This primary air stream, discharging from the periphery of L, flows axially between the shroud 29 and rim 21 towards the motor into a plenum or air discharge space defined between radial wall 20, rim 21 and member T, thence flows over the exterior of the windings W and the stator stack through the longitudinal passages, and also inwardly under the windings between the field and rotor to pass axially through and around the electrical or electromagnetic components of the motor for effective cooling. Some air also discharges from the plenum chamber through the arcuate slots 22 under these conditions.

The air leaving at the end of the stack is directed by D to pass over and around the end turns, the commutator, and the brushes and holders into the auxiliary fan space, discharging axially from which it passes thus about the spider and bearing socket of A and is turned out-

wardly by the end shield S to discharge under its rim. The auxiliary fan, of course, contributes to but is of minor effect in the moving of this main air stream from space 102 to space 101 or in motor cooling under these conditions.

However, in the event of notable or total blockage of air into the cleaning system suction side, an effective cooling volume of air discharged from the vacuum fan section disappears almost immediately. Under such conditions, the auxiliary fan function importantly appears, air being drawn in at the auxiliary slots or inlet ports 22 from the free atmosphere or space 101 into the plenum chamber from which it then discharges through the motor structure much in the manner previously described for normal cooling to prevent unacceptable or dangerously fast motor temperature rise.

The main air stream discharges both under S and in minor amount through slots 22 into space 101, in effect to the free atmosphere; and in event the auxiliary cooling path comes into use is drawn in at slots 22 from the free atmosphere to discharge to the atmosphere under shield S.

We claim:

1. An electric motor-fan unit including a motor section and a fan section with fan housing means mounted on, and having a main suction air inlet remote from, the motor section, said unit adapted for safe temperature operation despite obstruction of suction air flow to said inlet, and comprising:
 - first and second motor end bracket members with generally hollow body portions,
 - being each spanned at one end by a respective integral motor shaft bearing supporting structure and secured together in aligned endwise abutting relation at their other ends to provide a motor frame circumferentially enclosing a substantial part of the hereinafter named motor stator;
 - said first member having a fan section housing mounting integral rim portion external of its said integral structure and at least one motor ventilating air port axially inward of said rim portion;
 - said fan-section housing mounted on said rim portion;
 - a fan section end baffle fixed on the outer end of said first member;
 - a motor rotor with shaft supported at opposite ends by bearings in respective said integral structures and at one end the shaft projecting beyond said end baffle for supporting an impeller in the fan section;
 - a motor stator supported in said frame;
 - said end baffle defining with said first member an air flow space in communication with said port and adjacent end regions of said rotor and stator;
 - means including an air shield cap concentrically externally mounted on the said second member providing a second ventilating air port;
 - a motor ventilating fan on the other end of said shaft in an air flow space between said cap and stator;
 - said stator defining with said rotor and said frame air passages respectively internally and externally longitudinal of the stator and extending between said air flow spaces;
 - said end baffle having a periphery spaced inwardly from said rim portion to define a discharge passage into the first said air flow space for a vacuum air flow discharging from said fan section, and said ventilating fan acting to discharge air from the second air flow space through said second ventilating air port, whereby with vacuum air flow into said inlet unimpeded, the motor section is cooled by a part of the stream of vacuum air discharging from said fan section by an air flow path including said longitudinal passages and through said second air port, and the remainder of the vacuum air discharges from the first said port; and with vacuum air flow to said inlet impeded, the

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motor section is cooled by air drawn in at the first said port.

2. An air moving system comprising in combination, an electric motor-fan unit as described in claim 1, air intake piping connected to said inlet, and means mounting said unit in a manner affording substantially free air flow between the atmosphere and said ports.

3. A built-in residential type vacuum cleaning system comprising in combination, an electric motor-fan unit as described in claim 1; a plurality of normally closed vacuum cleaning hose connection fittings; housing means for said unit having means mounting said unit in a manner affording substantially free air flow between the atmosphere and said ports, said housing having between the unit inlet and a piping connection therein an air flow chamber adapted to serve as a dirt collecting chamber; and piping commonly connecting said fittings to said piping connection.

4. An electric motor-fan unit as described in claim 1, wherein said rim portion is outwardly radially and axially

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offset from and connected to the body portion of the first member by a circumferentially continuous wall portion, said wall portion provided adjacent the body portion of the first member with a circumferentially spaced series of slots as ventilating air ports, whereby to increase the cooling sweep of air drawn in said slots; said cap having a circumferential free edge spaced from the body portion of the second said member to define therewith a substantially continuous circumferentially extending said second air port.

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