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SUCTION UNIT, PARTICULARLY FOR CLEANING APPARATUS

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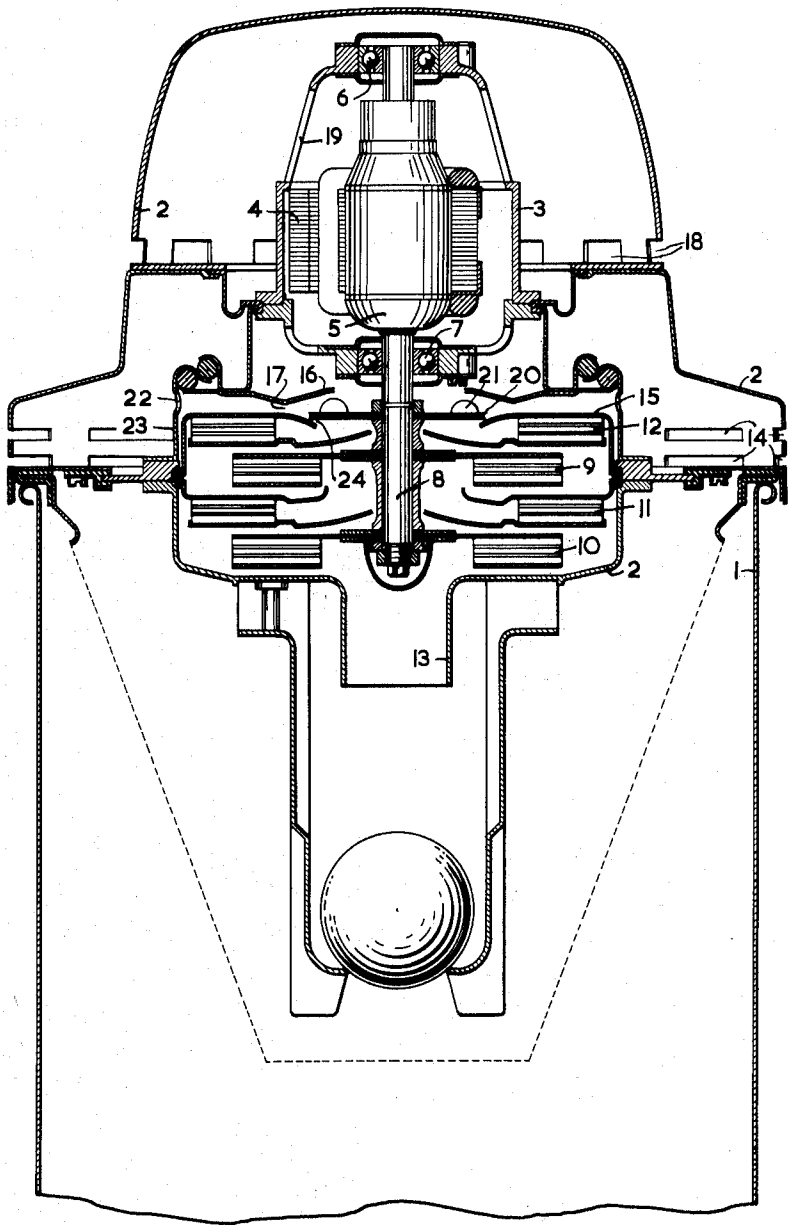

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SUCTION UNIT, PARTICULARLY FOR CLEANING APPARATUS

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This invention relates to suction units, particularly for cleaning apparatus, such units comprising an electric motor driven suction fan located in a housing having a first inlet for a primary flow of air generated by the fan, an outlet for said flow of air and a second inlet for an auxiliary flow of air serving for cooling the motor.

It is an object of the invention to provide for an effective cooling of the fan motor without an unnecessarily high power consumption for this purpose and to create a reliable safeguard against the primary flow of air, i.e. the flow generated by the fan, gaining access to the motor which often, particularly in smaller suction units, e.g. in domestic vacuum cleaners or water suction apparatus for cleaning purposes, is an open type motor which might be seriously damaged if dust, water drops or other foreign matter from the primary flow of air gained access to the interior of the motor. Suction units of the type concerned may, however, also be used e.g. for pneumatic conveyance of granular thermoplastic materials, and deposits of such materials between the stator and rotor of the motor might result in the complete jamming of the motor whereby the function of the suction unit is interrupted.

To attain the said and other objects the invention is characterised in that two stationary annular plates are located intermediate the suction fan and the associated drive motor, coaxially with the motor shaft, said annular plates being shaped so as to define between them an annular diffuser which diffuser is connected to said air outlet, and further in that a circular disc is secured to the motor shaft and extends into the space between said stationary plates with an outwardly decreasing spacing from the plate adjacent said fan to define therewith an annular nozzle.

The primary air flow generated by the suction fan and flowing through said annular nozzle, produces in the said nozzle a negative pressure which in turn, due to ejector action, generates or increases the flow of coolant air for the motor, which coolant flow is induced through said second inlet and, after having cooled the motor, is united with the primary air flow in the diffuser between the two stationary plates whereafter the combined or united flow of air is discharged through said air outlet.

Thus, according to this invention, the kinetic energy of the primary flow of air discharged from the suction fan is utilised for creating or ensuring the required cooling of the motor, and the vacuum produced by the flow of air through the annular nozzle ensures effectively, together with the disc secured to the motor shaft, which disc acts as a baffle plate, that foreign matter, such as dust or liquid particles, in the primary flow of air is kept away from the motor. The said advantages are obtained, as will be appreciated, no matter whether the auxiliary air flow for cooling the motor is produced exclusively by the negative pressure in the annular nozzle or whether there is provided a separate cooling fan which in such case may be of smaller dimensions, since it needs only have a capacity sufficient for cooling the motor at the operational condition when the primary flow of air is quite small or nil, for example due to throttling of the conduit associated with the suction fan.

According to a further feature of the invention there

may be provided vanes or fan blades on the face of the rotary disc, secured to the motor shaft, which faces the motor, whereby the disc will function as a separate cooling fan for the motor, at the same time providing an effective, friction-free sealing for the motor shaft.

Further objects and features of the invention will appear from the following detailed description when taken in connection with the accompanying drawing which shows a diagrammatical longitudinal section through a suction unit embodying the present invention and for use in a water suction apparatus for cleaning purposes, particularly for cleaning of floors and like surfaces.

The water suction apparatus illustrated in the drawing comprises a collecting container or receptacle **1** which is mounted on a wheeled frame not shown, and which is closed at its upper end by means of a detachable hood **2**. In the interior of the hood **2** there is secured a supporting member **3** for an electric motor consisting of a stator **4** secured to the supporting member **3** and a rotor **5** journalled in two ball bearings **6** and **7** in the supporting member **3**. The shaft **8** of the motor extends through the lower ball bearing **7** and carries two axially spaced impellers **9** and **10** provided with blower vanes. A guide apparatus **11** having suitably formed guide vanes is secured to the hood **2** and disposed between the two impellers **9** and **10**, and a further stationary guide apparatus **12** provided with similar guide vanes is disposed above the upper impeller **9**.

The lower portion of the hood **2** is shaped as a circular cylindrical, downwardly facing suction or induction funnel **13** which is coaxial with the motor shaft **8**, and the rotation of the motor **4**, **5** produces an air flow through said funnel from the interior of the container **1** through the suction unit **9–12** and out through openings **22** in an intermediate wall **23** within the hood **2**. From the interior of the hood **2** the air flow is exhausted to the atmosphere through openings **14** in the lateral wall of the hood **2**. The suction effect thus produced serves for sucking up a mixture of air and water through a nozzle or mouthpiece, not shown, connected with container **1**, and the water is collected in the container while the air is exhausted as explained above.

At its upper side the upper stationary guide apparatus **12** is defined by an annular plate **15** which extends inwardly past the inner edges of the guide vanes of the apparatus, and the inner edge zone of the plate **15** is curved smoothly or evenly downwards, as appears from the drawing. Above the plate **15** and substantially parallel to this plate there is provided a further stationary plate **16** having a corresponding, oppositely directed curvature. An outer portion of the plate **16** again curves upwardly whereby the interspace between the plates **15** and **16** forms, from the narrowest spacing of the plates at **17**, an annular diffuser for the above mentioned primary flow of air from the suction unit **9–12**. From the divergent end of the diffuser said air passes through the above mentioned openings **22** in the inner wall **23** and finally leaves the apparatus through the openings **14**.

Above the impellers **9** and **10** a flat circular disc **20** is secured to the motor shaft. The outer edge of the disc **20** extends beyond the inner edge of the plate **15** so as to form an annular nozzle **24** together with said plate. The primary air flow generated by the suction unit **9–12** produces, when flowing through the annular nozzle **24**, a negative pressure or vacuum which cooperates to create a coolant air flow which is induced separately from the primary air flow through openings **18** in the upper portion of the hood **2**. The coolant air flow passes through apertures **19** in the motor supporting member **3** and cools the motor, whereupon it is combined or united with the primary air flow in the above mentioned annular diffuser, and the

combined air flow is discharged through the openings **22** and **14**.

The upper face of the disc **20** is provided with a plurality of upstanding fins **21** serving as vanes or fan blades for increasing the intensity of the above mentioned flow of coolant air, induced through the openings **18**, for the motor **4, 5**. Furthermore, the lower face of the plate **20** functions as a baffle plate for catching water drops, if any, entrained by the flow of air through the blower unit **9–12** which have not in advance been separated from said flow, and thus provides an extra protection of the motor against the penetration of water.

The arrangement described constitutes an effective, friction-free sealing between the motor and the fan, and the sealing effect is due to the combined action of the negative pressure in the annular nozzle **24**, whereby air is prevented from flowing towards the motor, and of the rotary disc **20** secured to and rotating with the motor shaft **8**.

The cooling fan **20, 21** may be relatively small as it needs only have a capacity sufficient for cooling the motor in case the flow of air generated by the suction unit **9–12** should drop, wholly or substantially, to nil, for example by closing or heavy throttling of the opening of the above mentioned nozzle or mouth piece associated with the water suction apparatus. On the other hand, during normal operation of the apparatus, the flow of air through the suction unit is so abundant that it will easily ensure the increase of the flow of coolant air through the motor necessitated by the increased motor load. If the motor is designed so that it can operate without separate cooling in the above mentioned operational condition where the flow of air has been reduced, wholly or substantially, to nil, the blades or vanes **21** may be entirely omitted.

In addition to the above mentioned modification, various other modifications of the embodiment described will

be possible within the scope of this invention. The suction unit according to the invention might also be used for other purposes than for cleaning apparatus, for example for the pneumatical conveyance of pulverulent or granular materials, or as a ventilation blower wherein it is important that the vapours or gases sucked out are kept away from the blower motor.

I claim:

1. A suction unit, particularly for suction cleaning apparatus, comprising a housing, an electric motor located within said housing and having a stator and a rotary shaft, fan means secured to said motor shaft, two stationary annular plates located in said housing intermediate said fan means and said motor stator coaxially with said shaft, said annular plates being shaped so as to define between them an annular diffuser, a circular disc secured to said motor shaft intermediate said annular stationary plates and extending outwardly past the inner edge of the plate adjacent said fan means with an outwardly decreasing interspacing from said plate to define therewith an annular nozzle, a first air inlet connected to the suction side of said fan means, a second air inlet connected to the space surrounding said motor stator, and an air outlet connected to the discharge end of said annular diffuser.

2. A suction unit as claimed in claim **1**, wherein said disc secured to said shaft is provided with vane means on the face thereof facing said motor stator.

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