Title: SUCTION NOZZLE DEVICE

Abstract: A suction nozzle device movable on a surface to be cleaned, formed at least of two swirl chambers (1, 2), in which device the whirl chambers are open in regard to the surface to be cleaned and the device furnished with a blast arrangement (3) producing an air blast into the swirl chamber and a channel arrangement conveying air out of the swirl chamber. The blast air is arranged to travel from the first whirl chamber (1) to the second whirl chamber (2) etc., whereby the air is at least partly rotating in both chambers.
SUCTION NOZZLE DEVICE

The invention relates to a suction nozzle device movable on a surface to be cleaned and formed at least of two swirl chambers placed one after another and in which the whirl chambers are open in regard to the surface to be cleaned and the device including a blast arrangement producing an air blast into the swirl chamber and a channel arrangement conveying air out of the swirl chamber.

Previously known from application FI-972439 is a surfaces cleaning device with a swirl chamber, where the downward open swirl chamber is moved on the surface being cleaned. A strong air flow is conveyed downward from the swirl chamber front edge so that it hits at first the surface and then a part of the air makes a rotation in the chamber and another part flows out at once over the chamber rear edge to the discharge channel. The air that made the rotation escapes at least partly after having completed the rotation in the chamber. The air escaped from the chamber inclusive of material loosened from the surface is conveyed to a bigger chamber in the device, where the dirt is separated from the air and the air can be blasted back into circulation towards the chamber.

The problem of the above presented one-chamber solution is that the strong blast, viewed from the direction of the chamber travel motion, is conveyed from the chamber front edge diagonally towards the surface, whereby dirt material gets loose from the surface and, simultaneously, the blast also sucks some extra air from under the chamber into the chamber. This leads to disturbance on the chamber rear edge, since all flow including dirt material should be loosened from the surface, either into the rotation or diagonally into the upward rising discharge channel. Only the blocking plate of the chamber rear edge strives to hinder that from under the blocking plate no flow returns to the recently cleaned surface. The blocking plate function is difficult, since the surface is not always even and smooth. It is difficult, even impossible to make a blocking plate so tight that it could manage it.

By means of a suction nozzle device furnished with two whirl chambers as per this invention the above disclosed problems emerging in devices of this field are solved and by means of the invention the cleaning result is improved significantly. The suction
2 nozzle device according to this invention is characterised in that the blast air is arranged to travel from the first whirl chamber to the second whirl chamber etc., whereby the air is at least partly rotating in each whirl chamber.

5 Other advantageous embodiments are disclosed later on in the following dependent claims.

The advantage of the invention is that in using two whirl chambers, at least in the rear edge of the rearmost chamber, by means of a strong incoming blast from under the blocking plate into the chamber, a suction air flow is achieved to secure the cleaning result. At first, the blast air is conveyed to the rearmost chamber of the suction nozzle device and from there further to the first chamber, from where the air flow is discharged together with dirt material. The rear edge of the first chamber must not be very tight, since the chamber from behind is capable of handling litter that has got into the chamber from under the first chamber. Mainly, the rear edge of the first chamber shall take care of the air flow including litter and escaping diagonally upward into the discharge channel. In the advantageous embodiment, which has two whirl chambers, the rotations of air are in different directions.

20 In using one or more chambers the cleaning effect gets much better, a blast apparatus with more than one chamber is not needed, because the same flow circulates in all chambers and in the travel direction from under the rearmost blocking plate there is a suction flow into the chamber, whereby the cleaning result of the device becomes good already by one run.

25 In the following the invention is disclosed with reference to the enclosed drawing, where Figure 1 is a diagrammatic view of a two-chamber whirl suction nozzle.

Figure 2 is a diagrammatic view of a three-chamber whirl suction nozzle.

Figure 3 is a diagrammatic view of a two-chamber suction nozzle.

30 Figure 1 shows a two-chamber surfaces cleaning device furnished with wheels 9, with a container 5 and with an air filtrating filter 4 placed in the front direction in front of blast apparatus 3. The first whirl chamber 1 is the rearmost in the travel direction and the second chamber 2
the foremost. The blast arrives at the first chamber from the rear edge, which has also a blocking plate 6. The flow strives to suck more air from under the blocking plate 6. The suction effect is produced by the high speed of air in the channel at blocking plate 6, which speed drops immediately after the blocking plate, when the flow arrives at the chamber. The sped up flow at blocking plate 6 causes a remarkable drop of pressure in the channel so that from under the blocking plate open air strives to mix with the flow. This takes place at least in some extent on all nozzle edges, where blast air comes down passing the edge. One part of the air circulates in the chamber and one part continues to the second chamber 2. Blocking plate 7 steers the flow up from the surface. The flow circulates in the second chamber 2 and blows on the surface so that suction is generated into the chamber from under the front edge. This is not a disadvantage, on the contrary an advantage. Blocking plate 8 steers the flow from the surface up to the container.

Due to the filter and container 5 the turnover of air in the circulation is quite slight and the air coming through the filter is re-blasted into the circulation. Unavoidably, indeed some air escapes from under the edges but, on the other hand, replacing air is also absorbed from there instead.

Figure 2 shows a three-chamber solution, where in the flow direction the third chamber 10 is placed between the first and the second chamber. Chamber 10 has blocking plates 11 and 12 in the nozzle front and rear edge to block and to steer the flow.

Figure 3 shows a three-chamber solution, where the rotations run in the same direction. The flow strives out from under the front edge of second chamber 2, but that is no disadvantage, since then the flow and the litter return again for cleaning or for further blast forward.

Blast air can be humidified by water fog, which is sprayed into the circulating air in some proper point. An advantageous travel direction point to mix it with blast air is, for instance, at the second rearmost chamber, in order to prevent formation of dust.
CLAIMS

1. A suction nozzle device movable on a surface to be cleaned and formed at least of two swirl chambers (1, 2) placed one after another and in which the whirl chambers are open in regard to the surface to be cleaned and the device furnished with a blast arrangement (3) producing an air blast into the swirl chamber and a channel arrangement conveying air out of the swirl chamber characterized in that the blast air is arranged to travel from the first whirl chamber (1) to the second whirl chamber (2) etc., whereby the air is at least partly rotating in both chambers.

2. A suction nozzle device according to claim 1 characterized in that the rotation directions of the recirculated air of the first (1) and the second swirl chamber (2) are in reverse.

3. A suction nozzle device according to claim 1 characterized in that the rotation directions of the recirculated air of the first (1) and the second swirl chamber (2) are the same.

4. A suction nozzle device according to claim 1 characterized in that in the travel direction of the device there is in the nozzle rear end (6) a suction effect caused by blast air from the outside under the edge into the nozzle, in arranging for the air a great speed in the blast channel in the rear edge point (6) and, immediately, after the edge, expansion of channel into the chamber.

5. A suction nozzle device according to claim 1 characterized in that in a point somewhere on the circle of the air circulation air humidification is arranged by means of a spraying device or similar.
AMENDED CLAIMS

[Received by the International Bureau on 23 October 2002 (23.10.02):
original claim 1 replaced by amended claim 1, claims 2-5 are unchanged (1 page)]

1. A suction nozzle device movable on a surface to be cleaned and formed at least of two swirl chambers (1,2) placed one after another and in which the whirl chambers are open in regard to the surface to be cleaned and the device furnished with a blast arrangement (3) producing an air blast into the swirl chamber and a channel arrangement conveying air out of the swirl chamber characterized in that the blast air is arranged to travel from the first whirl chamber (1) by means of blocking plate (7) and an air channel to the second whirl chamber (2) etc., whereby the air is at least partly rotating in both chambers.

2. A suction nozzle device according to claim 1 characterized in that the rotation directions of the recirculated air of the first (1) and the second swirl chamber (2) are in reverse.

3. A suction nozzle device according to claim 1 characterized in that the rotation directions of the recirculated air of the first (1) and the second swirl chamber (2) are the same.

4. A suction nozzle device according to claim 1 characterized in that in the travel direction of the device there is in the nozzle rear end (6) a suction effect caused by blast air from the outside under the edge into the nozzle, in arranging for the air a great speed in the blast channel in the rear edge point (6) and, immediately, after the edge, expansion of channel into the chamber.

5. A suction nozzle device according to claim 1 characterized in that in a point somewhere on the circle of the air circulation air humidification is arranged by means of a spraying device or similar.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC: E01H 1/08, A47L 9/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: E01H, A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[X] Further documents are listed in the continuation of Box C.  
[X] See patent family annex.

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Name and mailing address of the ISA/Swedish Patent Office:
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer:
Anna Rapp / JA A
Telephone No. +46 8 782 25 00

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