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Dust extractor

Abstract

A dust extractor device that includes: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, and a control unit configured to adjust electric power of the motor based on the measured air flow rate.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application is a National Phase of PCT/FI2022/050733, filed on Nov. 8, 2022, which claims priority to Finnish Patent Application No. 20216196, filed on Nov. 23, 2021, the disclosures of each of which are hereby incorporated by reference in their entireties.

FIELD

(2) The present invention relates to a dust extractor.

BACKGROUND

(3) A dust extractor may be used for removing dust particles e.g. at a workshop or at a construction site. The dust extractor causes suction to remove dust particles. The dust extractor may draw an air flow via a hose, so as to remove dust particles, which are carried by the air flow. The dust extractor may comprise a filter for collecting the dust particles from the air flow. The filter and/or the hose may sometimes become blocked so that a sufficient air flow rate cannot be maintained.

(4) A dust extractor approved for extracting hazardous dust may comprise a flow sensor for monitoring air flow velocity in the suction hose. The dust extractor may provide a buzzer sound if the air flow velocity falls below a predetermined minimum value. The user is typically notified about the insufficient air flow velocity by generating a buzzer sound.

(5) With a typical dust extractor, the user may need to interact with the dust extractor in a situation where the air flow rate is not sufficient. The user may need to manually increase power level, in a situation where the air flow rate is not sufficient.

SUMMARY

(6) An object of the invention is to provide a dust extractor device. An object of the invention is to provide an apparatus, which comprises a dust extractor device. An object of the invention is to provide a method for extracting dust. An object of the invention is to provide a method for processing a surface.

(7) According to an aspect, there is provided a dust extractor device (**500**), comprising: a fan (FAN**1**) for causing an air flow (AIR**1**), a motor (MOTOR**1**) to rotate the fan (FAN**1**), a dust separator (FIL**1**) to separate dust particles (DUST**1**) from the air flow (AIR**1**), a flow measuring unit (FSEN**1**) for measuring air flow rate (Q.sub.AIR1) of the air flow (AIR**1**), and a control unit (CNT**1**) configured to adjust electric power (P.sub.500) of the motor (MOTOR**1**) based on the measured air flow rate (Q.sub.AIR1).

(8) The scope of protection sought for various embodiments of the invention is set out by the independent claims. The embodiments, if any, described in this specification that do not fall under the scope of the independent claims are to be interpreted as examples useful for understanding various embodiments of the invention.

(9) The control unit of the dust extractor may be configured to adjust the power level of the motor based on the measured air flow rate. Said control may e.g. reduce electric energy needed for extracting a given amount of dust with the dust extractor. Said control may e.g. increase the operating lifetime of the motor. Said control may e.g. allow more continuous dust extraction and/or surface processing, by reducing the need to interrupt the work due to insufficient air flow rate. Said control may e.g. reduce noise level of the dust extractor.

(10) Based on the air flow rate measurement, if the measured air flow rate is not sufficient with the currently selected hose diameter and power setting, the power setting of the motor may be increased to provide sufficient dust extraction. If a sufficient dust extraction is not achieved even at the highest power level of the motor, a buzzer may be activated, so as to let the user know that a sufficient dust extraction was not achieved.

(11) If the measured air flow rate is too low, the control unit may increase the rotation speed of the motor until the measured air flow rate is at a sufficient level.

(12) If sufficient air flow is not achieved at the maximum rotation speed of the motor, the control system may initiate an alarm signal. The alarm signal may be e.g. an audible alarm signal. For example, if sufficient air flow is not achieved at the highest power level the buzzer may be activated thus letting the user know that a sufficient air flow was not reached.

(13) In an embodiment, the flow sensor may be implemented by using pressure sensors and a rotation speed signal. The control system may be arranged to calculate the air flow rate from the pressure difference over the suction fan and from the rotation speed of the suction fan. The control system may form a flow rate signal indicative of the measured air flow rate. The control unit may

adjust the power of the motor based on the flow rate signal.
(14) The device may receive a hose diameter value via a user interface. The control system may determine a minimum air flow rate based the hose diameter value. The control system may adjust the power of the motor so as to keep the measured air flow above the determined minimum flow rate limit. If the measured air flow rate is lower than the determined minimum air flow rate, then the control unit may increase the power of the motor until the measured air flow rate reaches the needed flow rate, provided that the power of the motor remains lower than or equal to the maximum allowed power of the motor.
(15) The device may receive a hose diameter value and a target power value via the user interface. The control system may determine a target flow rate value based the hose diameter value and based on the target power value. The control system may determine a target air flow rate based the hose diameter value and based on the target power value. If the measured air flow rate is lower than the determined target air flow rate, then the control unit may increase the power of the motor until the measured air flow rate reaches the target value, provided that the power of the motor remains lower than or equal to the maximum allowed power of the motor.
(16) In an embodiment, the device may have quiet operating mode, where the motor and the fan are arranged to operate near the alarm flow rate limit in order to reduce or minimize emission of acoustic noise. The control unit may be arranged to adjust the power of the motor so as to keep the measured air flow rate a little bit over the alarm flow rate limit. The control unit may be arranged to adjust the power of the motor so as to keep the measured air flow rate substantially equal to a target air flow rate. The target air flow rate may be e.g. 10% higher than the alarm flow rate limit. The control unit may be arranged to adjust the power of the motor so as to keep the measured air flow rate above the alarm flow rate limit with a margin. The width of the margin may be e.g. 20% of the alarm flow rate limit. For example, the control unit may be arranged to adjust the power so that the measured air flow rate is greater than the alarm flow rate limit and smaller than 1.2 times the alarm flow rate limit.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) In the following examples, several variations will be described in more detail with reference to the appended drawings, in which
(2) FIG. **1** shows, by way of example, a surface processing system, which comprises a dust extractor,
(3) FIG. **2** shows, by way of example, method steps for controlling operation of the dust extractor,
(4) FIG. **3***a* shows, by way of example, the control system of the dust extractor,
(5) FIG. **3***b* shows, by way of example, providing a flow rate signal for the control unit,
(6) FIG. **4***a* shows temporal evolution of flow rate in a comparative example,
(7) FIG. **4***b* shows, by way of example, temporal evolution of flow rate and temporal evolution of the rotation speed of motor, in a situation where the power of the motor is controlled to keep air flow rate within a first target range, wherein the hose has a first internal diameter,
(8) FIG. **4***c* shows, by way of example, temporal evolution of flow rate and temporal evolution of the rotation speed of motor, in a situation where the power of the motor is controlled to keep air flow rate within a first target range, wherein the hose has a second internal diameter,
(9) FIG. **4***d* shows, by way of example, temporal evolution of flow rate and temporal evolution of the rotation speed of motor, in a situation where the power of the motor is controlled to keep air flow rate within a second target range, wherein the hose has the second internal diameter,
(10) FIG. **5** shows, by way of example, in a three-dimensional view, a dust extractor,
(11) FIG. **6** shows, by way of example, in a three-dimensional view, a dust extractor,

(12) FIG. **7***a* shows, by way of example, in a front view, a manual selector for inputting a target power setting, and
(13) FIG. **7***b* shows, by way of example, in a front view, a manual selector for inputting a hose diameter value,
(14) FIG. **8** shows, by way of example, in a three-dimensional view, a dust extractor and a hose, wherein the dust extractor comprises a reader to read a hose diameter value from a data carrier of the hose,
(15) FIG. **9** shows, by way of example, a hose without a data carrier,
(16) FIG. **10***a* shows, by way of example, a surface processing apparatus, which has communication capabilities, and
(17) FIG. **10***b* shows, by way of example, a surface processing apparatus, which has communication capabilities.

DETAILED DESCRIPTION

(18) Referring to FIG. **1**, the dust extractor **500** may comprise a rotating suction fan FAN**1** to cause a partial vacuum (p.sub.1), which in turn may draw an air flow AIR**1** through a hose HOSE**1** connected to the dust extractor **500**. The dust extractor **500** may comprise a motor MOTOR**1** for rotating the suction fan FAN**1**. Increasing the rotation speed N.sub.RPM of the motor MOTOR**1** and the fan FAN**1** may cause a lower inner pressure p.sub.1, thereby increasing the air flow rate Q.sub.AIR1 through the hose HOSE**1** and through the suction fan FAN**1**. Decreasing the rotation speed of the motor MOTOR**1** may cause a higher inner pressure p.sub.1, thereby decreasing the air flow rate Q.sub.AIR1.
(19) Increasing the rotation speed may increase consumption of electric energy and/or may shorten operating lifetime of the motor. Decreasing the rotation speed may decrease consumption of electric energy and/or may increase operating lifetime of the motor.
(20) The dust extractor **500** may be arranged to suck dust particles DUST**1**, which are carried by the air flow AIR**1**. The dust extractor **500** may also be called e.g. as a vacuum cleaner.
(21) The dust extractor **500** may comprise a particle separator FIL**1** to separate dust particles DUST**1** from the air flow AIR**1**. The particle separator FIL**1** may comprise e.g. a filter and/or a cyclone. The particle separator FIL**1** may collect the separated dust particles DUST**1**. The suction fan FAN**1** may draw the air flow AIR**1** through the particle separator FIL**1**.
(22) An apparatus **1000** for extracting dust DUST**1** may comprise the dust extractor **500** and a hose HOSE**1** connected to the dust extractor **500**. The hose HOSE**1** may convey an air flow AIR**1** and dust particles DUST**1** to the dust extractor **500**. The hose HOSE**1** may convey an air flow AIR**1** and dust particles DUST**1** e.g. from a working area of a power tool TOOL**1** to the dust extractor **500**. The apparatus **100** may optionally comprise a tool TOOL**1**. The tool TOOL**1** may be e.g. a sander, a drilling machine, or a sawing machine.
(23) The apparatus **1000** may be e.g. a surface processing apparatus. The surface processing apparatus **1000** may further comprise a power tool TOOL**1** for processing a surface SRF**1** of an object OBJ**1**. The power tool TOOL**1** may be e.g. a rotary sander, an orbital sander or a belt sander. The power tool TOOL**1** may comprise an abrasive article ABR**1**, which comprises abrasive grains. The tool TOOL**1** may comprise a supporting pad PAD**1**. The abrasive article ABR**1** may be attached to the pad PAD**1**. The tool TOOL**1** may comprise a motor MOTOR**2** for causing a movement of the abrasive article ABR**1** with respect to the surface SRF**1**. The tool TOOL**1** may comprise a motor MOTOR**2** for causing rotary and/or oscillatory movement of the abrasive article ABR**1** with respect to the surface SRF**1**. Pressing the abrasive article ABR**1** against the surface SRF**1** may generate dust particles DUST**1**, which may comprise particles released from the surface SRF**1** and/or particles released from the abrasive article ABR**1**. The tool TOOL**1** may comprise one or more openings OP**1** for extracting the released particles DUST**1** together with an air flow AIR**1**. The dust extractor **500** may be arranged to draw the dust-laden air flow AIR**1** via the openings OP**1** and via a flexible hose HOSE**1** to the inlet IN**1** of the dust extractor **500**.

(24) The hose HOSE**1** may operate as a flexible conduit for guiding the dust-laden air flow AIR**1**. The hose HOSE**1** may guide dust particles DUST**1** together with the air flow AIR**1** from a port PORT**1** of the tool TOOL**1** to the inlet IN**1** of the dust extractor **500**. The suction hose HOSE**1** may be detachably connectable to the inlet IN**1**.
(25) The inner diameter of the hose HOSE**1** may also be different from the inner diameter of the inlet IN**1**. The hose HOSE**1** may be connected to the inlet IN**1** e.g. by using an adapter connector ADA**1**. Hoses of several different diameters may be connected to the same dust extractor **500**. For example, a first hose having a first inner diameter (d.sub.H1=d.sub.1) may be connected to the dust extractor **500** during a first time period, and a second hose having a second different inner diameter (d.sub.H1=d.sub.2) may be connected to the dust extractor **500** during a second time period. The inner diameter (h.sub.H1) of the hose HOSE**1** may have an effect on the flow resistance and on the flow velocity of air flow guided via the hose.
(26) Operating safety of a user may require that the air flow velocity (v.sub.AIR1) in the hose HOSE**1** is greater than or equal to a minimum flow velocity value (v.sub.min1). The minimum flow velocity value may be e.g. 20 m/s. The minimum flow velocity (m/s) may determine a corresponding minimum air flow rate (L/s) for each inner diameter of the hose. L denotes liter. The unit of flow velocity may be e.g. m/s. The unit of flow rate may be e.g. L/s.
(27) The inner diameter d.sub.H1 of the hose HOSE**1** may be e.g. 18 mm. The cross-sectional shape of the hose may be substantially circular. When the hose diameter d.sub.H1=18 mm, then the condition v.sub.AIR1≥20 m/s may be ensured by keeping the air flow rate greater than or equal to 5.1 L/s.
(28) The inner diameter d.sub.H1 of the hose HOSE**1** may be e.g. 40 mm. When the hose diameter d.sub.H1=40 mm, then the condition v.sub.AIR1≥20 m/s may be ensured by keeping the air flow rate greater than or equal to 25.1 L/s.
(29) p.sub.0 denotes the ambient atmospheric pressure. Pressure near the power tool TOOL**1** and at the outlet OUT**1** of the dust extractor **500** may be substantially equal to the atmospheric pressure p.sub.0. The ambient pressure p.sub.0 is typically substantially equal to 101.3 kPa. p.sub.CHM1 denotes an internal pressure of the inlet chamber CHM**1** of the dust extractor **500**. The pressure p.sub.CHM1 may also denote the upstream pressure of the particle separator FIL**1** (e.g. filter). The pressure difference p.sub.0−p.sub.CHM1 may draw the dust-laded air flow AIR**1** from the abrasive article ABR**1** to the inlet chamber CHM**1** of the dust extractor **500** via the flexible hose HOSE**1**.
(30) The rotating fan FAN**1** may cause the partial vacuum p.sub.1, which prevails between the particle separator FIL**1** and the fan FAN**1**. p.sub.1 denotes an upstream pressure of the fan FAN**1** and downstream pressure of the particle separator FIL**1**. The pressure p.sub.1 may be the lowest pressure of the apparatus **1000**. p.sub.2 denotes a downstream pressure of the fan FAN**1**. The maximum pressure difference (p.sub.2−p.sub.1) over the fan FAN**1** may be e.g. in the range of 5 to 30 kPa.
(31) The dust extractor **500** may comprise a control unit CNT**1** for adjusting electric power of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1. The dust extractor **500** may comprise a control unit CNT**1** for controlling rotation speed of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1. The dust extractor **500** may comprise a flow measuring unit FSEN**1** for measuring the air flow rate Q.sub.AIR1.
(32) The dust extractor **500** may comprise one or more pressure sensors PSEN**1**, PSEN**2** for measuring the pressure difference p.sub.2−p.sub.1 over the fan FAN**1**. In an embodiment, the flow measuring unit FSEN**1** may be implemented by measuring the pressure difference p.sub.2−p.sub.1, and by calculating the measured flow rate Q.sub.AIR1 from the measured pressure difference p.sub.2−p.sub.1 and from the measured rotation speed of the fan FAN**1**. Consequently, the flow rate may be accurately measured with a minimum number of additional components. In particular, there is no need to use an additional constriction in order to measure the air flow rate.
(33) The dust extractor **500** may comprise a user interface UIF**1** for receiving user input from a

user and/or for providing information to the user. For example, the user may set a target power value P.sub.T1 and/or a hose diameter value d.sub.H1 by using the user interface UIF**1**. The control unit CNT**1** may subsequently control operation of the dust extractor **500** according to the target power value P.sub.T1 and according to the hose diameter value d.sub.H1.

(34) The control system SYS**1** of the dust extractor **500** may comprise the control unit CNT**1** and the flow measuring unit FSEN**1**. The control system SYS**1** may comprise the user interface UIF**1**. The control system SYS**1** may comprise a motor driving unit MDU**1** for driving the motor MOTOR**1** (FIG. **3***a*).

(35) FIG. **2** shows, by way of example, method steps for controlling operation of the dust extractor **500**.

(36) A target power value P.sub.T1 may be inputted to the control system SYS**1** in step #**1210**. The target power value P.sub.T1 may be inputted e.g. by using a user interface (UIF**1***a*).

(37) A hose diameter value d.sub.H1 may be inputted to the control system SYS**1** in step #**1220**. The hose diameter value d.sub.H1 may correspond to the inner diameter of the hose HOSE**1**, which is connected to the dust extractor **500**. The hose diameter value d.sub.H1 may be inputted e.g. by using a user interface (UIF**1***b*).

(38) An alarm flow rate limit Q.sub.MIN1 may be determined from the hose diameter value d.sub.H1 in step #**1230**. The alarm flow rate limit Q.sub.MIN1 may be determined so as to ensure that the flow velocity is e.g. greater than or equal to an alarm limit value v.sub.min1 in the hose HOSE**1**, which has the inner diameter d.sub.H1. The alarm limit value v.sub.min1 of the velocity may be e.g. 20 m/s.

(39) The target flow rate Q.sub.T1 may be determined in step #**1235**.

(40) The control system SYS**1** may determine the target air flow rate Q.sub.T1 from the selected target power level P.sub.T1. The control system SYS**1** may determine a target air flow rate Q.sub.T1 from the selected target power level P.sub.T1 according to a control function Q.sub.T1(P.sub.T1). For example, the control system SYS**1** may determine a target air flow rate Q.sub.T1 from the selected target power level P.sub.T1 such that the target air flow rate Q.sub.T1 corresponds to the selected target power level P.sub.T1 in a reference situation where the dust separator (filter FIL**1**) is clean, and only an unobstructed suction hose (HOSE**1**) having a predetermined nominal size is connected to the inlet IN**1**.

(41) The target flow rate Q.sub.T1 may also be determined from the target power value P.sub.T1 by taking into account the additional condition that the target flow rate Q.sub.T1 must be greater than or equal to the alarm flow rate limit Q.sub.MIN1. The target flow rate Q.sub.T1 may be increased e.g. if a first target flow rate value candidate (Q.sub.T1) determined from the target power value P.sub.T1 is lower than the alarm flow rate limit Q.sub.MIN1.

(42) The control system SYS**1** may be configured to determine the target flow rate Q.sub.T1 from the target power value P.sub.T1 so that the determined target flow rate Q.sub.T1 is substantially greater than the alarm flow rate limit Q.sub.MIN1, in order to provide a margin of safety.

(43) The control system SYS**1** may be configured to determine the target flow rate Q.sub.T1 from the target power value P.sub.T1 so that the determined target flow rate Q.sub.T1 is e.g. at least 10% greater than the alarm flow rate limit Q.sub.MIN1.

(44) The control system SYS**1** may be arranged to keep the measured air flow rate (Q.sub.AIR1(t)) substantially equal to the target air flow rate Q.sub.T1. For example, the control unit CNT**1** may be arranged to adjust the rotation speed (N.sub.RPM) of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1 so as to keep the difference (Q.sub.T1−Q.sub.AIR1) between the target flow rate Q.sub.T1 and the measured air flow rate Q.sub.AIR1 smaller than 10% times the target flow rate Q.sub.T1.

(45) For example, the control unit CNT**1** may be arranged to adjust the rotation speed (N.sub.RPM) of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1 so as to keep the difference (Q.sub.T1−Q.sub.AIR1) between the target flow rate Q.sub.T1 and the measured air

flow rate Q.sub.AIR1 smaller than the half width (HW.sub.RNG1.Math.Q.sub.T1) of the range target flow rate range RNG**1**. The coefficient HW.sub.RNG1 may be e.g. in the range of 2% to 20%. The coefficient HW.sub.RNG1 may be called e.g. as the relative half width of the target flow rate range RNG**1**.

(46) The target flow rate range RNG**1** may correspond to the target power value P.sub.T1, and the control system may be arranged to keep the measured air flow rate (Q.sub.AIR1(t)) within the target flow rate range RNG**1**.

(47) The target flow rate range RNG**1** has a lower limit Q.sub.T11 and an upper limit Q.sub.T12. The symbol HW.sub.RNG1 denotes the relative half width of the target flow rate range RNG**1**. HW.sub.RNG1=(Q.sub.T12−Q.sub.T11)/(Q.sub.T12+Q.sub.T11). The relative half width HW.sub.RNG1 may be e.g. in the range of 2% to 20%. The difference between the upper limit Q.sub.T12 and the midpoint (Q.sub.T12+Q.sub.T11)/2 of the target flow rate range RNG**1** is equal to HW.sub.RNG1 times the midpoint (Q.sub.T12+Q.sub.T11)/2. The difference between the midpoint (Q.sub.T12+Q.sub.T11)/2 and the lower limit Q.sub.T11 is equal to HW.sub.RNG1 times the midpoint (Q.sub.T12+Q.sub.T11)/2. The midpoint ((Q.sub.T12+Q.sub.T11)/2) of the target flow rate range RNG**1** may be e.g. substantially equal to the target air flow rate Q.sub.T1.

(48) The lower limit Q.sub.T11 of the target flow rate range RNG**1** may be checked in step #**1237**. If needed, the target flow rate range RNG**1** may be adjusted to ensure that the lower limit Q.sub.T11 is greater than or equal to the alarm flow rate limit Q.sub.MIN1. For example, the target flow rate range RNG**1** may be shifted such that the lower limit Q.sub.T11 is greater than or equal to the alarm flow rate limit Q.sub.MIN1. For example, the target air flow rate Q.sub.T1 may be increased such that the lower limit Q.sub.T11 of the target flow rate range RNG**1** is greater than or equal to the alarm flow rate limit Q.sub.MIN1.

(49) The control system SYS**1** may determine a minimum value for the target air flow rate Q.sub.T1 based on the alarm flow rate limit Q.sub.MIN1. If the target air flow rate Q.sub.T1 is lower than the minimum value, then the control system SYS**1** may adjust the target air flow rate Q.sub.T1 to be greater than or equal to the minimum value to ensure that that the lower limit Q.sub.T11 of the target flow rate range RNG**1** is greater than or equal to the alarm flow rate limit Q.sub.MIN1.

(50) A candidate target air flow rate (Q.sub.T1) and a candidate lower limit (Q.sub.T11) may be determined from the inputted target power value P.sub.T1. The candidate lower limit (Q.sub.T11) may be determined from the candidate target air flow rate (Q.sub.T1) e.g. by using a predetermined half width HW.sub.RNG1 of the target flow rate range RNG**1**. The control system SYS**1** may determine the (final) target flow rate Q.sub.T1 such that the lower limit Q.sub.T11 of the target flow rate range RNG**1** is equal to the candidate value (Q.sub.T11) or equal to (1+K.sub.SM) times the alarm flow rate limit Q.sub.MIN1, whichever is higher. The safety margin K.sub.SM may be e.g. in the range of 0% to 100%. The safety margin K.sub.SM may also be e.g. in the range of 10% to 100%, in order to provide improved safety and/or in order to avoid triggering an unjustified alarm during normal operation.

(51) The air flow rate Q.sub.AIR1(t) may be measured in step #**1240**.

(52) The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be controlled based on the measured air flow rate Q.sub.AIR1(t) in step #**1250**.

(53) The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be adjusted based on the measured air flow rate Q.sub.AIR1(t).

(54) The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be adjusted based on the measured air flow rate Q.sub.AIR1(t), so as to keep the measured air flow rate Q.sub.AIR1(t) substantially equal to the target air flow rate Q.sub.T1. The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be increased if the measured air flow rate Q.sub.AIR1(t) is smaller than the target flow rate Q.sub.T1.

(55) The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be

adjusted based on the measured air flow rate Q.sub.AIR1(t), so as to keep the measured air flow rate Q.sub.AIR1(t) greater than or equal to the lower limit Q.sub.T11.
(56) The power (P.sub.500) and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** may be adjusted based on the measured air flow rate Q.sub.AIR1(t), so as to keep the measured air flow rate Q.sub.AIR1(t) within the target range RNG**1**.
(57) The control unit CNT**1** may be arranged to adjust the rotation speed N.sub.RPM of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1 so as to keep the measured air flow rate Q.sub.AIR1 within the target flow rate range RNG**1**.
(58) The control unit CNT**1** may keep the measured air flow rate Q.sub.AIR1 higher than the alarm flow rate limit Q.sub.MIN1.
(59) The control unit CNT**1** may keep the measured air flow rate QAIR**1** substantially equal to the target air flow rate Q.sub.T1.
(60) The control unit CNT**1** may comprise e.g. a PID controller. One or more control parameters of the PID controller may be selected such that the control unit CNT**1** causes the dust extractor **500** to keep the measured air flow rate Q.sub.AIR1 substantially equal to the target air flow rate Q.sub.T1, by adjusting the rotation speed based on the measured air flow rate.
(61) One or more control parameters of the PID controller may be selected such that the control unit CNT**1** causes the dust extractor **500** to keep the measured air flow rate Q.sub.AIR1 within the target flow rate range RNG**1**, by adjusting the rotation speed based on the measured air flow rate.
(62) One or more control parameters of the PID controller may be selected such that the control unit CNT**1** causes the dust extractor **500** to keep the measured air flow rate Q.sub.AIR1 higher than the alarm flow rate limit Q.sub.MIN1, by adjusting the rotation speed based on the measured air flow rate.
(63) The measured air flow rate Q.sub.AIR1(t) may be compared with a minimum value Q.sub.MIN in step #**1260**.
(64) The control system SYS**1** may start an alarm signal if the measured air flow rate Q.sub.AIR1(t) is lower than the minimum value Q.sub.MIN (step #**1270**).
(65) The control system SYS**1** may continue normal operation if the measured air flow rate Q.sub.AIR1(t) is higher than the minimum value Q.sub.MIN. The control system SYS**1** may repeat the steps #**1240**-#**1260**.
(66) FIG. **3***a* shows, by way of example, a control system SYS**1** of the dust extractor device **500**.
(67) The control system SYS**1** may comprise a control unit CNT**1** for controlling rotation speed N.sub.RPM(t) of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1(t). The control unit CNT**1** may be implemented e.g. by one or more data processors. The control system SYS**1** may comprise a machine-readable memory MEM**1** for storing computer program code PRG**1**. The program code PRG**1**, when executed by one or more processors of the control unit CNT**1** may cause the control unit CNT**1** to control electric power P.sub.500 and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1** based on the measured air flow rate Q.sub.AIR1(t). The control system SYS**1** may comprise a machine-readable memory MEM**2** for storing operating parameters PAR**1** of the extractor device **500**. The operating parameters PAR**1** may specify e.g. a minimum flow velocity VMIN**1**. The operating parameters PAR**1** may specify e.g. a minimum air flow rates Q.sub.MIN1 for different hose diameters d.sub.H1.
(68) The control system SYS**1** may comprise a user interface UIF**1** for receiving user input from a user. The user interface UIF**1** may also provide information to the user.
(69) The user interface UIF**1** may comprise an input device UIF**1***a* for inputting a target power setting P.sub.T1. The user interface UIF**1** may comprise an input device UIF**1***b* for inputting a hose diameter value d.sub.H1. The user interface UIF**1** may comprise an output device UIF**1***c* for providing an alarm signal ALARM**1** to the user, e.g. an alarm sound signal and/or a visual alarm signal.
(70) The control system SYS**1** may comprise a flow measuring unit FSEN**1** for measuring the air

flow rate Q.sub.AIR1 of the air flow AIR**1**, which is drawn via the inlet IN**1** by the fan FAN**1**.
(71) The flow measuring unit FSEN**1** may provide a flow rate signal S.sub.FLOW indicative of the measured air flow rate Q.sub.AIR1(t) of the air flow AIR**1** passing through the fan FAN**1**. The control unit CNT**1** may control operation of the motor MOTOR**1** based on the flow rate signal S.sub.FLOW. The control unit CNT**1** may adjust the power P.sub.500 and/or the rotation speed N.sub.RPM of the motor MOTOR**1** based on the flow rate signal S.sub.FLOW. The flow rate signal S.sub.FLOW may be e.g. a digital signal in order to facilitate reliable data processing operations.
(72) In an embodiment, the flow measuring unit FSEN**1** may comprise a flow calculation unit FCAL**1**. The flow calculation unit FCAL**1** may be configured to calculate the measured air flow rate Q.sub.AIR1(t) from the pressure difference p.sub.2−p.sub.1 and from the rotation speed of the FAN**1**. The flow calculation unit FCAL**1** may be implemented e.g. by one or more data processors (PROC**1**). The flow calculation unit FCAL**1** may be implemented e.g. by a calculation algorithm running on one or more data processors (PROC**1**). The flow calculation unit FCAL**1** may form the flow rate signal S.sub.FLOW.
(73) The flow measuring unit FSEN**1** may comprise one or more pressure sensors PSEN**1**, PSEN**2** for measuring a pressure difference p.sub.2−p.sub.1 over the fan FAN**1**.
(74) For example, a first pressure sensor PSEN**1** may measure an upstream pressure p.sub.1 of the fan FAN**1** at a first position POS**1**. For example, a second pressure sensor PSEN**2** may measure a downstream pressure p.sub.2 of the fan FAN**1** at a second position POS**2**. Alternatively, a pressure difference sensor (e.g. PSEN**1**) may be arranged to measure the pressure difference p.sub.2−p.sub.1 between the positions POS**2**, POS**1**. The first pressure sensor PSEN**1** may form a pressure signal S.sub.P1 indicative of the pressure p.sub.1 or the pressure difference p.sub.2−p.sub.1. The second pressure sensor PSEN**2** may form a pressure signal S.sub.P2 indicative of the pressure p.sub.2.
(75) The control system SYS**1** may comprise a rotation speed indicator SEN**3** for providing a signal S.sub.RPM indicative of the rotation speed of the FAN**1**. The control system SYS**1** may be arranged to measure the flow rate Q.sub.AIR1 by calculating the flow rate Q.sub.AIR1 from the measured pressure difference p.sub.2−p.sub.1 and from the rotation speed of the fan FAN**1**. The control system SYS**1** may be arranged to measure the flow rate Q.sub.AIR1 from one or more signals S.sub.P1, S.sub.P2 of the pressure sensors PSEN**1**, PSEN**2** and from the rotation speed signal S.sub.RPM. The control system SYS**1** may be arranged to calculate the flow rate Q.sub.AIR1 by using the signals S.sub.RPM, S.sub.P1, S.sub.P2. The control system SYS**1** may be arranged to calculate the flow rate Q.sub.AIR1 from the measured pressure difference p.sub.2−p.sub.1 and from the rotation speed e.g. by using a regression function. Parameter values specifying the regression function may be stored in a memory (e.g. MEM**2**) of the control system SYS**1**.
(76) The fan FAN**1** may be e.g. an axial fan and/or a centrifugal fan. The pressure difference (p.sub.2−p.sub.1) over the fan FAN**1** may depend on the air flow rate Q.sub.AIR1 and on the rotation speed of the fan FAN**1**. Consequently, the air flow rate Q.sub.AIR1 may be calculated from the measured pressure difference (p.sub.2−p.sub.1) and from the rotation speed of the fan FAN**1**.
(77) The rotation speed indicator SEN**3** may form the rotation speed signal S.sub.RPM e.g. from a frequency of a driving electric current EC**1** of the motor MOTOR**1**. The rotation speed indicator SEN**3** may form the rotation speed signal S.sub.RPM e.g. from a commutation frequency of the motor MOTOR**1**. The rotation speed indicator SEN**3** may comprise a sensor for measuring the rotation speed of the motor MOTOR**1** and/or to measure the rotation speed of the fan FAN**1**.
(78) The rotation speed signal S.sub.RPM may be indicative of the measured rotation speed of the motor MOTOR**1** and/or indicative of the measured rotation speed of the fan FAN**1**. The rotation speed of the fan FAN**1** may be proportional to the rotation speed of the motor MOTOR**1**. The rotation speed of the fan FAN**1** may be equal to the rotation speed of the motor MOTOR**1**. The rotation speed of the FAN**1** may be determined from the rotation speed of the motor MOTOR**1**. The rotation speed of the motor MOTOR**1** may be determined from the rotation speed of the fan FAN**1**,

respectively.

(79) The motor MOTOR**1** may be e.g. an asynchronous or synchronous electric motor. The motor MOTOR**1** may be e.g. an alternating current motor or a direct current motor. The motor MOTOR**1** may be e.g. an universal motor. The motor MOTOR**1** may be e.g. brushless direct current motor.

(80) The control system SYS**1** may comprise a motor driving unit MDU**1** for providing one or more electric currents EC**1** to the motor MOTOR**1** according to motor control signal S.sub.MOTOR1. The motor driving unit MDU**1** may comprise e.g. power transistors and/or thyristors for providing the electric currents EC**1** for the motor MOTOR**1**. The motor driving unit MDU**1** may provide one or more electric currents EC**1** in response to a motor control signal S.sub.MOTOR1. The control unit CNT**1** may form the motor control signal S.sub.MOTOR1 based on the measured air flow rate Q.sub.AIR1.

(81) In an embodiment, the rotation speed indicator SEN**3** may determine the rotation speed of the fan FAN**1** from the motor control signal S.sub.MOTOR1 and/or from the frequency of the one or more electric currents EC**1**.

(82) The dust extractor device **500** may comprise a dust chamber CHM**1** for guiding the dust-laded air flow AIR**1** from the inlet IN**1** to the dust separator FIL**1** and/or for collecting the separated dust DUST**1**. The dust extractor device **500** may comprise an air flow chamber CHM**2** for guiding the air flow AIR**1** from the fan FAN**1** to the outlet OUT**1**.

(83) FIG. **3***b* shows providing the flow rate signal S.sub.FLOW to the control unit CNT**1**. The control system SYS**1** may comprise a flow calculation unit FCAL**1** for forming the flow rate signal S.sub.FLOW. The flow calculation unit FCAL**1** may calculate the flow rate Q.sub.AIR1 from the measured pressure difference p.sub.2−p.sub.1 and from the rotation speed of the fan FAN**1**.

(84) The control unit CNT**1** may be implemented e.g. by executing program code PRG**1** by one or more data processors PROC**1** of the control system SYS**1**. Also the flow calculation unit FCAL**1** may be implemented by executing program code by one or more data processors PROC**1** of the control system SYS**1**. In an embodiment, one or more data processors PROC**1** may be arranged to carry out data processing for the control unit CNT**1** and also for the flow calculation unit FCAL**1**.

(85) FIG. **4***a* shows a comparative example where the motor of the dust extractor is driven with a constant RMS voltage level, e.g. with 230 V 50 Hz alternating voltage. RMS means root mean square. The motor may be e.g. a universal motor. In this comparative example, the control unit does not control the rotation speed based on the measured air flow rate. The upper curve shows temporal evolution of the measured air flow rate Q.sub.AIR1(t), and the lower curve shows the rotation speed N.sub.RPM(t) of the motor MOTOR**1**.

(86) The motor may be started in the beginning (at time t.sub.0). The rotation speed N.sub.RPM(t) may reach a steady state value N.sub.RPM,4 at a time t.sub.4. The flow rate Q.sub.AIR1(t) may reach a maximum value at the time t.sub.4. The symbol t denotes time.

(87) A dust source may provide dust particles. For example, the power tool TOOL**1** may operate as a dust source. To the first approximation, the dust source (TOOL**1**) may be assumed to generate dust DUST**1** at a constant rate (e.g. 0.1 g/s). To the first approximation, the dust extractor may be assumed collect substantially all dust, which is generated by the dust source (TOOL**1**). The filter FIL**1** of the dust extractor **500** may separate and collect the dust from the air flow AIR**1**. The collected dust may form a dust layer on the filter FIL**1**. The increasing thickness of the dust layer may increase the total flow resistance of the filter FIL**1** so that the air flow rate Q.sub.AIR1(t) is reduced with time.

(88) In this comparative example, the motor of the dust extractor may be driven with the constant RMS voltage level, wherein the electric power of the motor decreases with decreasing air flow rate Q.sub.AIR1(t). The power needed for rotating the fan FAN**1** at a given rotation speed may be proportional to the air flow rate and the pressure difference over the fan. Reducing the air flow rate Q.sub.AIR1(t) may reduce the power needed for rotating the fan FAN**1**, thereby reducing the electric power of the motor. When the motor is driven with constant voltage without using a control

unit for controlling the rotation speed, then the motor may respond to the decreasing load by increasing the rotation speed even if the electric power of the motor is decreased.
(89) In this comparative example, the maximum rotation speed N.sub.RPM,MAX of the motor would be attained in a situation where the air flow rate Q.sub.AIR1(t) would zero, e.g. if the hose would be completely blocked. In this comparative example, the minimum electric power of the motor would be attained in a situation where the air flow rate Q.sub.AIR1(t) would be zero.
(90) The increasing thickness of the dust layer of the filter FIL**1** may eventually cause that the air flow rate Q.sub.AIR1(t) decreases below an alarm limit value Q.sub.MIN1 at a time t.sub.20.
(91) A partial blockage may happen between the times t.sub.5, t.sub.7. As the consequence, the flow rate Q.sub.AIR1(t) may be temporarily reduced between the times t.sub.5, t.sub.7.
(92) The temporarily reduced flow rate Q.sub.AIR1(t) may temporarily reduce the load of the electric motor during the partial blockage between the times t.sub.5, t.sub.7. The electric motor may respond by temporarily increasing the rotation speed, when driven at the constant (RMS) voltage level (e.g. 230 V). However, the increased rotation speed is not sufficient to fully compensate the reduced air flow rate. Furthermore, the electric power and the electric current of the motor may be reduced during the partial blockage between the times t.sub.5, t.sub.7.
(93) FIG. **4***b* shows, by way of example, controlled operation of the dust extractor **500**. The control unit CNT**1** of the dust extractor **500** may adjust power P.sub.500 and/or rotation speed N.sub.RPM(t) of the motor MOTOR**1**, so as to keep the air flow rate Q.sub.AIR1(t) within a predetermined target range RNG**1**. The target range RNG**1** may have a lower limit Q.sub.T11 and an upper limit Q.sub.T12. The target flow rate Q.sub.T1 may specify e.g. the lower limit Q.sub.T11 of the range RNG**1**.
(94) The motor may be started in the beginning (at time t.sub.0). The control unit CNT**1** may set the rotation speed N.sub.RPM(t) to a suitable value, e.g. N.sub.RPM,3, such that the air flow rate Q.sub.AIR1(t) is within the predetermined range RNG**1**. The control unit CNT**1** may set the rotation speed N.sub.RPM(t) to a suitable value, e.g. N.sub.RPM,3, such that the air flow rate Q.sub.AIR1(t) is greater than or equal to the lower limit Q.sub.T11. The rotation speed N.sub.RPM(t.sub.3) may reach the (suitable) value N.sub.RPM,3 at the time t.sub.3, so that the air flow rate Q.sub.AIR1(t) may be within the predetermined range RNG**1** at the time t.sub.3. The rotation speed value N.sub.RPM,3 of the motor MOTOR**1** may be substantially smaller than the maximum value N.sub.RPM,MAX.
(95) The flow resistance of the filter FIL**1** may increase e.g. at the same constant rate as in the comparative example of FIG. **4***a*. The control unit CNT**1** of the dust extractor **500** may compensate the increasing flow resistance by increasing the rotation speed N.sub.RPM(t) of the motor MOTOR**1**, based on the measured air flow rate Q.sub.AIR1(t). The control unit CNT**1** may adjust the electric power P.sub.500(t) and/or the rotation speed N.sub.RPM(t) so as to keep the measured air flow rate Q.sub.AIR1(t) higher than or equal to the lower limit Q.sub.T11. The control unit CNT**1** may adjust the electric power P.sub.500(t) and/or the rotation speed N.sub.RPM(t) so as to keep the measured air flow rate Q.sub.AIR1(t) within the predetermined range RNG**1**. The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) as the flow resistance increases, so as to keep the measured air flow rate Q.sub.AIR1(t) within the predetermined range RNG**1**.
(96) The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) until the rotation speed N.sub.RPM(t) reaches the maximum value N.sub.RPM,MAX at the time t.sub.10.
(97) The air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**1** during a time period T.sub.3 between the times t.sub.3 and t.sub.10.
(98) After the time t.sub.10, the control unit CNT**1** cannot any more compensate the increasing flow resistance by increasing the rotation speed N.sub.RPM(t).
(99) After the time t.sub.10, the measured air flow rate Q.sub.AIR1(t) begins to decrease e.g. due to the increasing flow resistance of the filter FIL**1**.
(100) The measured air flow rate Q.sub.AIR1(t) may decrease below the alarm limit value

Q.sub.MIN1 at a time t.sub.21. The control system SYS**1** may be arranged to provide an alarm signal ALARM**1** when the measured air flow rate Q.sub.AIR1(t) is lower than the alarm limit value Q.sub.MIN1.
(101) In order to further demonstrate the control, the partial blockage may happen between the times t.sub.5, t.sub.7. As the consequence, the control unit CNT**1** may temporarily increase the power P.sub.500 and/or rotation speed N.sub.RPM(t) so as to keep the measured air flow rate Q.sub.AIR1(t) higher than or equal to the minimum level Q.sub.T11. The control unit CNT**1** may temporarily increase the rotation speed N.sub.RPM(t) so as to keep the measured air flow rate Q.sub.AIR1(t) within the predetermined range RNG**1**. The control unit CNT**1** may reduce the rotation speed N.sub.RPM(t) to a normal level after removal of the partial blockage. The motor MOTOR**1** may have a finite response time to a change of the target speed of rotation. Consequently, the measured air flow rate Q.sub.AIR1(t) may have a small dip immediately after the time t.sub.5 when the partial blockage happens. The measured air flow rate Q.sub.AIR1(t) may have a small peak immediately after the time t.sub.7 when the partial blockage is removed.
(102) FIG. **4***c* shows, by way of example, controlled operation of the dust extractor **500** in a situation where the inner diameter (d.sub.H1=d.sub.2) of the hose HOSE**1** is larger than in case of FIG. **4***b*. The flow resistance of the hose may be smaller, which means that the air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**1** by using a lower rotation speed (N.sub.RPM,2), when compared with the case of FIG. **4***b.*
(103) The motor MOTOR**1** may be started in the beginning at the time t.sub.0. The control unit CNT**1** may set the rotation speed N.sub.RPM(t) to a suitable value, e.g. N.sub.RPM,2, such that the air flow rate Q.sub.AIR1(t) is within the predetermined range RNG**1**. The rotation speed N.sub.RPM(t.sub.2) at the time t.sub.2 may be equal to N.sub.RPM,2. The air flow rate Q.sub.AIR1(t) may be within the predetermined range RNG**1** at the time t.sub.2. The rotation speed value N.sub.RPM,2 of the motor MOTOR**1** may be smaller than the rotation speed value N.sub.RPM,3 of FIG. **4***b.*
(104) The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) as the flow resistance increases, so as to keep the measured air flow rate Q.sub.AIR1(t) within the predetermined range RNG**1**.
(105) The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) until the rotation speed N.sub.RPM(t) reaches the maximum value N.sub.RPM,MAX at the time t.sub.11.
(106) The air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**1** during a time period T.sub.2, between the times t.sub.2 and t.sub.11.
(107) The lower flow resistance of the hose HOSE**1** may cause that the air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**1** longer than in case of FIG. **4***b.*
(108) After the time t.sub.11, the measured air flow rate Q.sub.AIR1(t) begins to decrease e.g. due to the increasing flow resistance of the filter FIL**1**.
(109) The measured air flow rate Q.sub.AIR1(t) may decrease below the alarm limit value Q.sub.MIN2 at a time t.sub.22. The control system SYS**1** may be arranged to provide an alarm signal ALARM**1** when the measured air flow rate Q.sub.AIR1(t) is lower than the alarm limit value Q.sub.MIN2.
(110) The hose diameter (d.sub.H1=d.sub.2) of FIG. **4***c* is greater than the hose diameter (d.sub.H1=d.sub.1) of FIG. **4***b*. The alarm value Q.sub.MIN2 denotes the minimum air flow rate (L/s) needed to ensure the minimum air velocity (m/s) in case of the greater hose diameter (d.sub.H1=d.sub.2). The alarm value Q.sub.MIN1 denotes the minimum air flow rate (L/s) needed to ensure the minimum air velocity (m/s) in case of the smaller hose diameter (d.sub.H1=d.sub.1). The value Q.sub.MIN2 may be greater than the value Q.sub.MIN1, due to the different inner diameter of the hoses HOSE**1**.
(111) FIG. **4***d* shows, by way of example, operation of the dust extractor **500** in a situation where the minimum target flow rate Q.sub.T21 is lower than in case of FIG. **4***c*. The control unit CNT**1**

may keep the air flow rate Q.sub.AIR1(t) in a second range RNG**2**, which is different from the range RNG**1**. The target range RNG**2** may have a lower limit Q.sub.T21 and an upper limit Q.sub.T22. The inner diameter of the hose HOSE**1** may be the same (d.sub.H1=d.sub.2) as in case of FIG. **4***c*.
(112) The motor MOTOR**1** may be started in the beginning at the time t.sub.0. The control unit CNT**1** may set the rotation speed N.sub.RPM(t) to a suitable value, e.g. N.sub.RPM,1, such that the air flow rate Q.sub.AIR1(t) is within the predetermined range RNG**2**. The rotation speed N.sub.RPM(t.sub.1) at the time t.sub.1 may be equal to N.sub.RPM,1. The air flow rate Q.sub.AIR1(t) may be within the predetermined range RNG**2** at the time t.sub.1. The rotation speed value N.sub.RPM,1 of the motor MOTOR**1** may be smaller than the rotation speed value N.sub.RPM,2 of FIG. **4***c*.
(113) The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) as the flow resistance increases, so as to keep the measured air flow rate Q.sub.AIR1(t) within the predetermined range RNG**2**.
(114) The control unit CNT**1** may increase the rotation speed N.sub.RPM(t) until the rotation speed N.sub.RPM(t) reaches the maximum value N.sub.RPM,MAX at the time t.sub.12.
(115) The air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**2** during a time period T.sub.1, between the times t.sub.1 and t.sub.12.
(116) The lower air flow rate may be maintained by using a weaker partial vacuum p.sub.1. Consequently, the air flow rate Q.sub.AIR1(t) may be kept within the predetermined range RNG**2** longer than in case of FIG. **4***c*.
(117) After the time t.sub.12, the measured air flow rate Q.sub.AIR1(t) begins to decrease e.g. due to the increasing flow resistance of the filter FIL**1**.
(118) The measured air flow rate Q.sub.AIR1(t) may decrease below the alarm limit value Q.sub.MIN2 at a time t.sub.22. The control system SYS**1** may be arranged to provide an alarm signal ALARM**1** when the measured air flow rate Q.sub.AIR1(t) is lower than the alarm limit value Q.sub.MIN2.
(119) FIG. **5** shows, by way of example, in a three-dimensional view, a dust extractor **500**.
(120) The dust extractor **500** may comprise one or more input devices UIF**1***a*, UIF**1***b* for inputting a target power setting P.sub.T1 and/or the hose diameter d.sub.H1 to the control system SYS**1**. The dust extractor **500** may comprise an input device UIF**1***a* for inputting a target power setting P.sub.T1. The dust extractor **500** may comprise an input device UIF**1***b* for inputting a hose diameter d.sub.H1.
(121) The dust extractor **500** may comprise one or more output devices UIF**1***c* e.g. for providing an audible and/or visual alarm signal ALARM**1**. The output device UIF**1***c* may comprise e.g. buzzer or a loudspeaker for providing an audible alarm signal. The output device UIF**1***c* may comprise e.g. a lamp for providing a visual alarm signal.
(122) SX, SY, and SZ denote orthogonal directions.
(123) Referring to FIG. **6**, the dust extractor **500** may optionally comprise e.g. an electric socket SOC**1** for distributing electric power e.g. for the power tool TOOL**1**. The dust extractor **500** may comprise an input device UIF**1***d* for setting an operating mode of the dust extractor **500**. For example, the dust extractor **500** may have a first operating mode where the dust extractor **500** operates continuously, and the dust extractor **500** may have a second operating mode where the dust extractor **500** operates only when electric power is drawn from the socket SOC**1**. The socket SOC**1** may also be called as an electric connector.
(124) The dust extractor **500** may optionally comprise an input device UIF**1***e* for starting a filter cleaning sequence. The filter cleaning sequence may comprise e.g. applying a reverse air pulse and/or shaking the filter FIL**1**. The dust extractor **500** may be arranged to clean the filter FIL**1** e.g. by using a reverse air pulse and/or by shaking the filter FIL**1**. The control system SYS**1** may be configured to start a reverse air pulse and/or shaking of the filter based on an input received via the

input device UIF**1***e*. The input device UIF**1***e* may comprise e.g. a push button. The human user may manually push the button so as to start a filter cleaning sequence.
(125) The dust extractor **500** has an inlet IN**1** for connecting with the dust hose HOSE**1**. The dust extractor **500** may have an outlet OUT**1** for discharging the substantially particle-free air flow AIR**1** into ambient air, after the dust particles DUST**1** have been separated from the air flow AIR**1**.
(126) The input device UIF**1***a*, UIF**1***b*, UIF**1***d*, and/or UIF**1***e* may be implemented e.g. by a rotary handle, by a sliding handle, and/or by one or push buttons.
(127) FIG. **7***a* shows, by way of example, an input device UIF**1***a* for inputting a target air flow rate Q.sub.T1 to the control system SYS**1**. The input device UIF**1***a* may comprise e.g. a movable handle KN**1**. The input device UIF**1***a* may comprise e.g. a rotary handle KN**1**, which may rotated about an axis AX**1**. A human user may manually move the handle KN**2** so as to select a target flow rate Q.sub.T1.
(128) Each position of the handle KN**1** may correspond to a (different) nominal target power level P.sub.T1, which in turn may correspond to a (different) target air flow rate Q.sub.T1. The input device UIF**1***a* may comprise one or more visual indicators MRK**1**, which may visually associate the different positions of the handle KN**1** with different power level values.
(129) For example, the handle KN**1** may be moved to a first position POS**11** to select a minimum target power level P.sub.T1. For example, the handle KN**1** may be moved to a second position POS**12** to select a medium target power level. For example, the handle KN**1** may be moved to a third position POS**13** to select a maximum target power level.
(130) The input device UIF**1***a* may provide the selected target power level P.sub.T1 as an input to the control system SYS**1**.
(131) Each position of the handle KN**1** may correspond to a different target air flow rate Q.sub.T1, which in turn may correspond to a different nominal target power level P.sub.T1 of the motor. For example, the handle KN**1** may be moved to a first position POS**11** to select a minimum target air flow rate. For example, the handle KN**1** may be moved to a second position POS**12** to select a medium target air flow rate. For example, the handle KN**1** may be moved to a second position POS**13** to select a maximum target air flow rate. The input device UIF**1***a* may provide the selected target air flow rate as an input to the control system SYS**1**. Each different target air flow rate Q.sub.T1 may correspond to a different target power level P.sub.T1 of the motor e.g. in a situation where the dust separator FIL**1** is clean, and the unobstructed suction hose HOSE**1** has a nominal size (e.g. d.sub.H1=d.sub.1).
(132) FIG. **7***b* shows, by way of example, an input device UIF**1***b* for inputting a hose diameter value h.sub.H1 to the control system SYS**1**. The input device UIF**1***b* may comprise e.g. a rotary handle KN**2**, which may rotated about an axis AX**2**. A human user may manually move the handle KN**2** so as to select a hose diameter value h.sub.H1 from a plurality of selectable values (e.g. 21 mm, 27 mm, 32 mm, 36 mm, 37 mm). The user may move the handle KN**2** so that the input device UIF**1***b* indicates a hose diameter value h.sub.H1, wherein the input device UIF**1***b* may provide said hose diameter value h.sub.H1 as an input to the control system SYS**1**. The indicated hose diameter value h.sub.H1 may be selected to correspond to the actual diameter of the hose HOSE**1** connected to the dust extractor **500**. The input device UIF**1***a* may comprise e.g. a plurality of visual markings MRK**2**, MRK**3**, MRK**4**, MRK**5**, MRK**6** to indicate the selectable diameter values (e.g. 21 mm, 27 mm, 32 mm, 36 mm, 38 mm).
(133) In an embodiment, the dust extractor may comprise e.g. a keypad or a touch screen for receiving user input. In an embodiment, the user interface UIF**1** (UIF**1***a*, UIF**1***b*, UIF**1***c*, UIF**1***d*, UIF**1***e*) may also be implemented e.g. by an application running on a mobile phone. The (mobile) user interface UIF**1** may communicate with the dust extractor **500** e.g. via wireless communication.
(134) Referring to FIG. **8**, the dust extractor device **500** may optionally comprise a reader READ**1** to read a hose diameter value d.sub.H1 from a data carrier TAG**1** of a hose HOSE**3**, in an instance where a hose HOSE**3** comprising the data carrier TAG**1** is connected to the inlet IN**1** of the device

500. The reader READ**1** may provide a hose size signal (S.sub.DHOSE), which is indicative of the hose diameter value d.sub.H1 obtained from the data carrier TAG**1**. The control system SYS**1** may use the obtained hose diameter value d.sub.H1 as an input for controlling operation of the device **500**. The control system SYS**1** of the device **500** may be arranged to determine the limit value Q.sub.MIN1 of the air flow rate from the hose diameter value d.sub.H1.
(135) The data carrier TAG**1** may comprise machine readable data indicative of the hose diameter value d.sub.H1 of the hose HOSE**3**. The data carrier TAG**1** may e.g. an RFID tag, and the reader READ**1** may be an RFID reader. RFID means radio frequency identification. The data carrier TAG**1** may e.g. an NFC tag, and the reader READ**1** may be an NFC reader. NFC means near field communication. The data carrier TAG**1** may comprise e.g. an optically readable code, and the reader READ**1** may be an optical reader. The data carrier TAG**1** may comprise e.g. a magnetically readable code, and the reader READ**1** may be suitable for reading the magnetically readable code.
(136) Referring to FIG. **9**, a hose HOSE**1** may also be provided such that the hose HOSE**1** does not comprise a data carrier TAG**1**, or the data carrier TAG**1** of the HOSE**1** does not comprise machine-readable data indicative of the hose diameter value of the hose HOSE**1**.
(137) One or more hoses (HOSE**3**) may comprise a data carrier TAG**1**, wherein one or more hoses (HOSE**1**) do not comprise a data carrier TAG**1**. A first hose (HOSE**1**) without the data carrier TAG**1** may be connectable to the dust extractor device **500**, and also a second hose (HOSE**3**) with a data carrier TAG**1** may be connectable to the dust extractor device **500**. The dust extractor device **500** may be compatible with a hose regardless of whether the hose has a data carrier or not. The control system SYS**1** may be arranged to ensure proper operation of the device **500** with both types of hoses.
(138) The dust extractor device **500** may optionally comprise a presence sensor SEN**4** to detect whether a hose (e.g. HOSE**1** or HOSE**3**) is connected to the inlet IN**1** or not. The presence sensor SEN**4** may provide a presence signal (S.sub.DHOSE), which indicates whether a hose (e.g. HOSE**1** or HOSE**3**) is connected to the inlet IN**1** or not. The control system SYS**1** may determine based on the presence signal (S.sub.DHOSE) whether a hose is connected to the inlet IN**1** or not. The sensor SEN**4** may be e.g. mechanical sensor or optical sensor to detect whether a hose (e.g. HOSE**1** or HOSE**3**) is connected to the inlet IN**1** or not, after a previous hose has been disconnected. The sensor SEN**4** may comprise e.g. a microswitch, which is actuated when a hose is connected or disconnected.
(139) In an embodiment, the control system SYS**1** of the device **500** may be arranged to require inputting or confirming the hose diameter value d.sub.H1 via the user interface UIF**1***b* in an instance where the sensor SEN**4** indicates that a hose is connected to the inlet IN**1**, but machine-readable data indicative of the hose diameter value cannot be read via the reader READ**1**.
(140) For example, the control system SYS**1** of the device **500** may be arranged to provide a visual indication and/or an audio indication that the user needs to input or confirm the hose diameter value after connecting a hose, e.g. by manually operating the user interface UIF**1***b*. For example, the user interface UIF**1** may comprise an output device (e.g. UIF**1***c*) for providing a visual indication and/or an audio indication that the user needs to input or confirm the hose diameter value. The control system SYS**1** may be arranged to continue providing the visual indication and/or the audio indication until the control system SYS**1** detects that user input is provided via the user interface (e.g. UIF**1***b*). The control system SYS**1** may be arranged to continue providing the visual indication and/or the audio indication until the hose diameter value has been inputted or confirmed.
(141) The control system SYS**1** may be arranged to determine the limit value Q.sub.MIN1 of the air flow rate from the hose diameter value d.sub.H1, in an instance where data indicative of the hose diameter value d.sub.H1 can be read from the data carrier TAG**1** of the hose, by using the reader READ**1**.
(142) In an embodiment, the control system SYS**1** may determine the limit value Q.sub.MIN1 from a hose diameter value d.sub.H1 obtained via the reader READ**1**, instead of a hose diameter value

d.sub.H1 obtained via the user interface (UIF**1***b*), in an instance where the hose diameter value d.sub.H1 obtained via the reader READ**1** is available. The machine-readable data read via the reader READ**1** may override manually inputted data. The control system SYS**1** may give a higher priority for the hose diameter value d.sub.H1 obtained via the reader READ**1**. The control system SYS**1** may be arranged to ignore a hose diameter value inputted via the user interface UIF**1***b* if machine-readable data indicative of the hose diameter value is obtained via the reader READ**1**. The control system SYS**1** may be arranged to disable indication that the user needs to confirm the hose diameter value, if the machine-readable data is obtained via the reader READ**1**.
(143) In an embodiment, the flow measuring unit FSEN**1** may also be implemented e.g. by guiding the flow AIR**1** via a constriction, by measuring an upstream pressure and a downstream pressure of a constriction, and by determining the flow rate from the upstream pressure and the downstream pressure. In an embodiment, the flow measuring unit FSEN**1** may also be implemented e.g. by using a miniature anemometer for measuring the velocity at the outlet OUT**1**.
(144) Referring to FIG. **10***a*, the dust extractor **500** may comprise an electrical connector SOC**1** and/or a communication unit RXTX**1** for controlling operation of the power tool TOOL**1**. The apparatus **1000** may have an operating mode where the power tool TOOL**1** is caused to stop generating dust, in a situation where the air flow rate Q.sub.AIR1 cannot be maintained higher than or equal to a predetermined lower limit (Q.sub.T11 or Q.sub.MIN1). Said operating mode may be called e.g. as enhanced safety mode or forced stopping mode. Said operating mode may be user-selectable. Said operating mode may be enabled and disabled e.g. by using the user interface UIF**1** of the dust extractor **500**.
(145) The apparatus **1000** may sometimes be operated in such a noisy environment that the user may fail to notice an alarm signal. The user may sometimes be so focused on his work that he fails to notice an alarm signal. Automatic control of the power of the power tool TOOL**1** may improve operating safety, by stopping production of dust DUST**1** in a situation where safe air flow speed cannot be maintained. The automatic control of the power of the power tool TOOL**1** may be an additional safety feature to protect the user from hazardous dust.
(146) In an embodiment, the operating power of the power tool TOOL**1** may be reduced in a situation where the air flow rate Q.sub.AIR1 cannot be maintained higher than or equal to a predetermined limit (Q.sub.T11 or Q.sub.MIN1). Reducing the power of the power tool TOOL**1** is likely to catch attention of the user. Reducing the power of the power tool TOOL**1** may improve detectability of the alarm signal (ALARM**1**).
(147) The control system SYS**1** may cause the power tool TOOL**1** to stop generating dust in a situation where the air flow rate (Q.sub.AIR1) cannot be maintained higher than or equal to an alarm limit value (Q.sub.MIN1). The control system SYS**1** may e.g. stop operation of the motor MOTOR**2** of the power tool TOOL**1**. In particular, if the dust extractor can't achieve at least the minimum required flow velocity (v.sub.min1), then the control system SYS**1** may cause the power tool TOOL**1** to stop generating dust. Consequently, production of the dust may be stopped, and there is no more dust being piled up in the hose HOSE**1**.
(148) After the control system SYS**1** has caused the power tool TOOL**1** to stop generating dust, the control system SYS**1** may optionally stop also the operation of the motor (MOTOR**1**) of the dust extractor **500**.
(149) The dust extractor **500** may comprise an electrical connector SOC**1** for supplying electrical power to a power tool TOOL**1**, wherein the control system SYS**1** may reduce or switch off electrical power P.sub.TOOL1 transferred via the electrical connector SOC**1** in a situation where the air flow rate Q.sub.AIR1 cannot be maintained higher than or equal to a predetermined lower limit (Q.sub.T11 or Q.sub.MIN1). The control system SYS**1** may reduce or switch off the electrical power P.sub.TOOL1 in a situation where the air flow rate Q.sub.AIR1 is smaller than the predetermined lower limit (Q.sub.T11 or Q.sub.MIN1). The control system SYS**1** may be arranged to reduce or stop transfer of electrical power (P.sub.TOOL1) via the electrical connector SOC**1** to

the power tool TOOL**1**. For example, a relay may be used to disable power to the socket SOC**1**. The electrical power P.sub.TOOL1 may be transferred from the connector SOC**1** to the power tool TOOL**1** e.g. via a cable CBL**1**.
(150) The dust extractor **500** may comprise a communication unit RXTX**1** for transmitting a control signal COM**1** to a power tool TOOL**1**. The control system SYS**1** may transmit a stopping instruction (COM**1**.sub.S) or a reducing instruction (COM**1**.sub.R) via the communication unit (RXTX**1**) in a situation where the air flow rate (Q.sub.AIR1) cannot be maintained higher than or equal to a predetermined lower limit (Q.sub.T11 Or Q.sub.MIN1). The control system SYS**1** may transmit a stopping instruction (COM**1**.sub.S) or a reducing instruction (COM**1**.sub.R) in a situation where the air flow rate (Q.sub.AIR1) is smaller than the predetermined lower limit (Q.sub.T11 or Q.sub.MIN1). The stopping instruction (COM**1**.sub.S) may be an instruction for causing the power tool to stop generating dust. The reducing instruction (COM**1**.sub.R) may be an instruction for reducing power of the power tool. For example, the power tool TOOL**1** may be arranged to stop generating dust according to a stopping instruction (COM**1**.sub.S) received from the control system SYS**1**. For example, transmitting the stopping instruction (COM**1**.sub.S) to the power tool TOOL**1** may cause the control unit CNT**2** of the power tool TOOL**1** to set the power tool TOOL**1** to a standby operating mode. For example, transmitting the stopping instruction (COM**1**.sub.S) to the power tool TOOL**1** may cause the control unit CNT**2** to disconnect the motor MOTOR**2** from a power source (e.g. from a battery, from a mains network (MAINS**1**), or from the electrical connector (SOC**1**).
(151) The power tool TOOL**1** may comprise a communication unit RXTX**2** for receiving instructions (COM**1**.sub.S, COM**1**.sub.R) from the dust extractor **500**. For example, the power tool TOOL**1** may be arranged to stop operation of the motor MOTOR**2** according to a stopping instruction (COM**1**.sub.S) received via the communication units RXTX**1**, RXTX**2**. The power tool TOOL**1** may comprise a control unit CNT**2** for controlling operation of the power tool TOOL**1**. The control unit CNT**2** may control the operation e.g. based on instructions (COM**1**.sub.S,COM**1**.sub.R) and/or based on user input received from the user. The instructions may also be called as commands.
(152) The communication units RXTX**1**, RXTX**2** may communicate with each other directly and/or via one or more auxiliary devices. The communication units RXTX**1**, RXTX**2** may communicate by wired and/or wireless communication. The communication units RXTX**1**, RXTX**2** may communicate e.g. via Bluetooth, wireless local area network, and/or wireless mobile communications network.
(153) The power tool TOOL**1** may also comprise a user interface UIF**2** for receiving user input from the user and/or for providing information to the user UIF**2**.
(154) For example, the user interface UIF**1** and/or UIF**2** may be arranged to provide an alarm signal (ALARM**1**) to the user if the measured air flow rate Q.sub.AIR1 is smaller than the alarm limit value (Q.sub.MIN1).
(155) In an embodiment, the user interface UIF**1** and/or UIF**2** may be arranged to suggest emptying the dust extractor **500** when needed. The user interface UIF**1** and/or UIF**2** may be arranged to suggest replacing a dust bag and/or a dust filter FIL**1** when needed.
(156) Referring to FIG. **10***b*, the control system SYS**1** may optionally check whether the power tool TOOL**1** has a capability to receive and execute instructions (COM**1**.sub.S,COM**1**.sub.R) transmitted by the control system SYS**1** or not. Operating the apparatus **1000** may comprise performing a handshake procedure between the control system SYS**1** and the power tool TOOL**1**. The method may comprise transmitting handshake signals COM**1**.sub.A, COM**1**.sub.B, COM**1**.sub.E. In an embodiment, the operation of the power tool TOOL**1** may be enabled only if the handshake signals COM**1**.sub.A, COM**1**.sub.B, COM**1**.sub.E are successfully transmitted and received.
(157) The control system SYS**1** may send an interrogation signal COM**1**.sub.A to the power tool

TOOL**1**. The power tool TOOL**1** may respond to the interrogation signal COM**1**.sub.A by sending a valid response signal COM**1**.sub.B, which indicates that the power tool TOOL**1** has a capability to receive and execute instructions (COM**1**.sub.S,COM**1**.sub.R) transmitted by the control system SYS**1**. Alternatively, the power tool TOOL**1** may respond to the interrogation signal COM**1**.sub.A by sending a wrong response or by not responding at all. The control system SYS**1** may be arranged to enable operation of the power tool TOOL**1** only if the control system SYS**1** receives the valid response signal COM**1**.sub.B from the power tool in response to the interrogation signal COM**1**.sub.A. The control system SYS**1** may enable operation of the power tool TOOL**1** e.g. by sending an enabling instruction COM**1**.sub.E to the power tool TOOL**1**, after receiving the valid response signal COM**1**.sub.B. The power tool TOOL**1** may be arranged to enable operation of the power tool TOOL**1** only after receiving and executing the enabling instruction COM**1**.sub.E. The power tool TOOL**1**, and in particular the motor MOTOR**2** may receive operating power P.sub.TOOL1 from a power source (e.g. from a battery, from a mains network (MAINS**1**), or from the electrical connector (SOC**1**).
(158) The control system SYS**1** may be arranged to provide an alarm or a warning in a situation where the control system SYS**1** does not receive a valid response signal COM**1**.sub.B in response to the interrogation signal COM**1**.sub.A. The control system SYS**1** may provide the alarm or the warning e.g. via the user interface UIF**1**.
(159) In an embodiment, the apparatus **1000** may have the forced stopping operating mode also in a situation where the dust extractor device of the apparatus is not arranged to automatically control power based on measured air flow rate. In an embodiment, the apparatus may have the forced stopping operating mode also in a situation where the dust extractor device does not have the capability to automatically control power based on measured air flow rate.
(160) For the person skilled in the art, it will be clear that modifications and variations of the systems, products, apparatuses, devices and methods according to the present invention are perceivable. The figures are schematic. The particular embodiments described above with reference to the accompanying drawings are illustrative only and not meant to limit the scope of the invention, which is defined by the appended claims.

Claims

1. A dust extractor device, comprising: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, and a control unit configured to adjust electric power of the motor based on the measured air flow rate, and a user interface for inputting a hose diameter value, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to compare the measured air flow rate with an alarm limit value, wherein the control system is arranged to provide an alarm signal if the measured air flow rate is smaller than the alarm limit value, wherein the control system of the device is arranged to determine the alarm limit value from the hose diameter value.
2. The device of claim 1, wherein the control system of the device is arranged to provide a flow rate signal indicative of the measured air flow rate, wherein the control unit is configured to adjust the electric power of the motor based on the flow rate signal.
3. The device of claim 2, wherein the control unit is arranged to keep the air flow rate higher than a predetermined lower limit by adjusting the rotation speed of the motor based on the flow rate signal.
4. The device of claim 1, further comprising a user interface for inputting a target power value,

wherein the control unit is arranged to adjust the rotation speed of the motor based on the measured air flow rate so as to keep the measured air flow rate substantially equal to a target flow rate, which corresponds to the target power value.

5. The device of claim 4, wherein the control unit is arranged to adjust the rotation speed of the motor based on the measured air flow rate so as to keep the difference between the target flow rate and the measured air flow rate smaller than 10% of the target flow rate.

6. The device of claim 1, wherein the control unit is arranged to keep the air flow rate within a predetermined target flow rate range by adjusting the rotation speed of the motor based on the measured air flow rate.

7. The device of claim 1, comprising a user interface for inputting a target power value, wherein the control unit is arranged to adjust the rotation speed of the motor based on the measured air flow rate so as to keep the measured air flow rate within a target flow rate range, which corresponds to the target power value.

8. The device of claim 1, comprising an electrical connector for supplying electrical power to a power tool, wherein the control system of the device is arranged to reduce or switch off electrical power transferred via the electrical connector in a situation where the measured air flow rate is smaller than the alarm limit value.

9. The device of claim 1, comprising a communication unit for transmitting a control signal to a power tool, wherein the control system of the device is arranged to transmit a stopping instruction and/or a reducing instruction via the communication unit in a situation where the measured air flow rate is smaller than the alarm limit value, wherein the stopping instruction is an instruction for causing the power tool to stop generating dust particles, and wherein the reducing instruction is an instruction for reducing power of the power tool.

10. A dust extractor device, comprising: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, a control unit configured to adjust electric power of the motor based on the measured air flow rate, and a reader to read machine-readable data indicative of a hose diameter value from a data carrier of a hose, in an instance where the hose comprising the data carrier is connected to an inlet of the device, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to compare the measured air flow rate with an alarm limit value, wherein the control system is arranged to provide an alarm signal if the measured air flow rate is smaller than the alarm limit value, wherein the control system of the device is arranged to determine the limit value from the hose diameter value obtained via the reader.

11. An apparatus for extracting dust, the apparatus comprising: a dust extractor device, and a hose for conveying an air flow and dust particles to the dust extractor device, the hose comprising a data carrier, wherein the dust extractor device comprises: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, a control unit configured to adjust electric power of the motor based on the measured air flow rate, and a reader to read machine-readable data indicative of a hose diameter value from the data carrier of the hose, in an instance where the hose is connected to an inlet of the device, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to compare the measured air flow rate with an alarm limit value, wherein the control

system is arranged to provide an alarm signal if the measured air flow rate is smaller than the alarm limit value, wherein the control system of the device is arranged to determine the limit value from the hose diameter value obtained via the reader.

12. A dust extractor device, comprising: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, a control unit configured to adjust electric power of the motor based on the measured air flow rate, and an electrical connector for supplying electrical power to a power tool, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to reduce or switch off electrical power transferred via the electrical connector in a situation where the measured air flow rate is smaller than an alarm limit value.

13. A dust extractor device, comprising: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, and a control unit configured to adjust electric power of the motor based on the measured air flow rate, a communication unit for transmitting a control signal to a power tool, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to transmit a stopping instruction and/or a reducing instruction via the communication unit in a situation where the measured air flow rate is smaller than an alarm limit value, wherein the stopping instruction is an instruction for causing the power tool to stop generating dust particles, and wherein the reducing instruction is an instruction for reducing power of the power tool.

14. An apparatus comprising: a dust extractor device, and a power tool, wherein the dust extractor device comprises: a fan for causing an air flow, a motor to rotate the fan, a dust separator to separate dust particles from the air flow, a flow measuring unit for measuring air flow rate of the air flow, a control unit configured to adjust electric power of the motor based on the measured air flow rate, and a communication unit for transmitting a control signal to the power tool, wherein the flow measuring unit comprises a rotation speed indicator unit to provide a rotation speed signal indicative of the rotation speed of the fan, and one or more pressure sensors to measure a pressure difference over the fan, wherein a control system of the device is arranged to measure the air flow rate by calculating the air flow rate from the pressure difference and from the rotation speed of the fan, wherein the control system of the device is arranged to transmit a stopping instruction and/or a reducing instruction via the communication unit in a situation where the measured air flow rate is smaller than an alarm limit value, wherein the stopping instruction is an instruction for causing the power tool to stop generating dust particles, and wherein the reducing instruction is an instruction for reducing power of the power tool.