(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 342 351 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.03.2024 Bulletin 2024/13

(21) Application number: **22197230.0**

(22) Date of filing: **22.09.2022**

(51) International Patent Classification (IPC):
A47L 9/28 *(2006.01)* ***A47L 11/40*** *(2006.01)*
A47L 7/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A47L 9/2857; A47L 7/0095; A47L 9/28; A47L 11/4011

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Valentini, Guido**
20122 Milano (IT)

(72) Inventor: **Valentini, Guido**
20122 Milano (IT)

(74) Representative: **Wörz, Volker Alfred**
Wörz Patentanwälte PartG mbB
Gablenberger Hauptstraße 32
70186 Stuttgart (DE)

(54) **REMOTE CONTROL FOR CONTROLLING AN OPERATION STATUS OF A SUCTION DEVICE**

(57) The invention refers to a remote control (50) for controlling an operation status of a suction device (2). The remote control (50) comprises a radio transmitter (88) for transmitting a first radio signal (30) to the suction device (2) for turning on or off the suction device (2). It is suggested that the remote control (50) further comprises a radio receiver (90) for receiving a second radio signal (54) from a communication device (32) located at a second end (16) of a suction hose (12), which is connected to a suction opening (10) of the suction device (2) with its first end (14) and to an air outlet (18) of a hand-held electric or pneumatic power tool (20) with its opposite second end (16). The communication device (32) detects a current operation status of the hand-held electric or pneumatic power tool (20) and emits the second radio signal (54) indicative of the current operation status of the hand-held electric or pneumatic power tool (20). The remote control (50) derives from the received second radio signal (54) the current operation status of the hand-held electric or pneumatic power tool (20) and transmits a respective first radio signal (30) in order to automatically turn on or off the suction device (2) depending on the derived current operation status of the hand-held electric or pneumatic power tool (20).

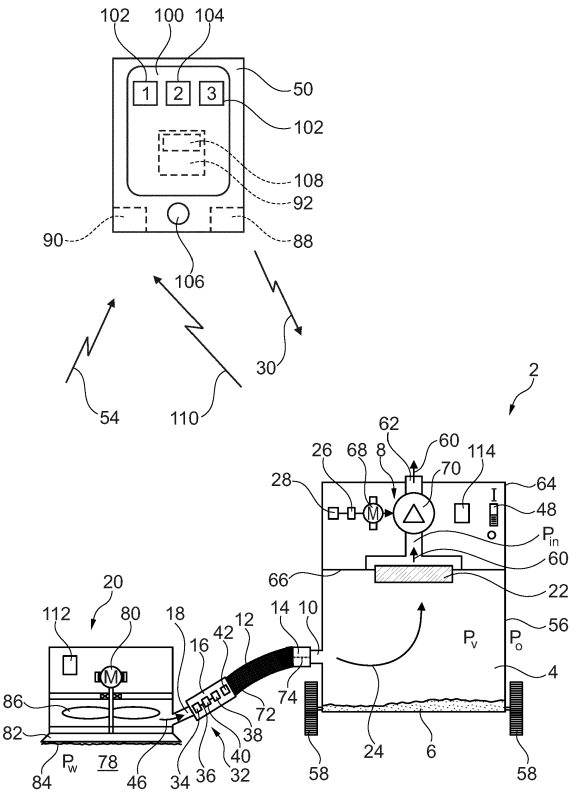

Fig. 3

EP 4 342 351 A1

Description

[0001] The present invention refers to a remote control adapted for controlling an operation status of a suction device, in particular a vacuum cleaner or a dust extraction system. The remote control comprises a radio transmitter for transmitting a first radio signal to the suction device for turning on or off the suction device.

[0002] The invention further refers to a suction device, in particular a vacuum cleaner or a dust extraction system, comprising a remote control for controlling an operation status of the suction device, and to a computer programme application programmed to be executed on a microprocessor of a smartphone, the computer programme application further being programmed in order to turn the smartphone into a remote control for controlling an operation status of a suction device, using a built-in radio transmitter already present in the smartphone.

[0003] Suction devices of the above identified kind are generally known in the form of robotic vacuum cleaners which autonomously move around on a predefined space, e.g. an apartment floor, with the help of sensors (e.g. ultrasonic sensors, infrared sensors or the like). These autonomous robotic vacuum cleaners often are equipped with a remote control for controlling an operation status of the vacuum cleaner. This kind of vacuum cleaner is used in private households or small office spaces and merely designed to vacuum and, possibly also, to mop the floor. This kind of vacuum cleaner is not adapted for use with hand-held electric or pneumatic power tools in order to aspire dust generated by the power tool during its intended use.

[0004] When using a suction device in connection with a hand-held power tool, an air outlet of the power tool is connected to a suction opening of the suction device by means of a pneumatic suction hose. It is difficult or at least cumbersome to synchronise the operating time of the suction device with that of the power tool. The idea is to turn on the suction device at least during operation of the power tool and to turn off the suction device again when or shortly after the power tool is switched off again.

[0005] To this end, EP 21 175 076.5 suggests a suction device which is automatically activated and possibly also deactivated based on a radio signal generated and transmitted by a communication device upon activation of the hand-held power tool and received by a radio receiver of the suction device. The communication device is located at or near a second end of a suction hose, which with its first end is connected to a suction opening of the suction device and with its opposite second end to an air outlet of a hand-held electric or pneumatic power tool. The suction device aspires through the suction hose the dust generated by the power tool during its intended use.

[0006] The communication device comprises a vibration sensor which is adapted to sense vibrations caused during operation of the power tool. Therefore, switching on the power tool will automatically generate a respective radio signal and turn on the suction device. Similarly, switching off the power wool will automatically generate a respective modified radio signal and turn off the suction device, possibly with a short delay. However, such a suction device is not provided with a remote control.

[0007] The object of the present invention is to provide the user of the power tool with an enhanced user experience and, in particular, to allow the user to manually control an operation status of a suction device by means of a remote control.

[0008] In order to solve this object, the present invention suggests a remote control comprising the features of claim 1. In particular, starting from the remote control of the above identified kind, it is suggested that

> the remote control further comprises a radio receiver for receiving a second radio signal from a communication device located either at or near a second end of a suction hose, which is connected to a suction opening of the suction device with its first end and to an air outlet of a hand-held electric or pneumatic power tool with its opposite second end, or at the hand-held electric or pneumatic power tool itself,
> the communication device adapted for detecting a current operation status of the hand-held electric or pneumatic power tool and for emitting the second radio signal indicative of the current operation status of the hand-held electric or pneumatic power tool, and in that
> the remote control is adapted for deriving from the received second radio signal the current operation status of the hand-held electric or pneumatic power tool and to transmit a respective first radio signal in order to automatically turn on or off the suction device depending on the derived current operation status of the hand-held electric or pneumatic power tool.

[0009] The present invention is not simply an aggregation of a remote control to the suction device known from EP 21 175 076.5. Rather, the remote control suggested in the present invention has particular characteristics and advantages, which a simple remote control for suction devices does not have. In particular, the radio signal from the communication device is not directly received by the radio receiver of the suction device. Instead, the radio signal is relayed to the radio receiver of the suction device via the remote control. In particular, it is suggested that the radio signal is received by the remote control (in the form of the so-called second radio signal), then the remote control performs a processing or pre-processing functionality with respect to the received radio signal and generates a further radio signal (the so-called first radio signal). Finally, the further radio signal is transmitted from the remote control to the radio receiver of the suction device. Thus, the remote control basically acts as an intermediate processing or pre-processing unit for the radio signal transmitted by the communication device and received by the radio receiver of the suction device.

[0010] The remote control can also simply relay the second radio signal received communication device in the form of the first radio signal transmitted to the suction device, i.e. both signals having the same format and/or corresponding to the same standard. This has the advantage that the user of the power tool, who in general would also be the user of the remote control, can have influence on the content of the first radio signal. For example, the first radio signal could be influenced by manual input from the user provided by means of the remote control. In particular, the second radio signal, containing information to turn on the suction device, could be influenced by the user by manual input through the remote control in that the remote control transmits a second radio signal containing information to turn off or keep turned off the suction device. Similarly, the second radio signal, containing information to turn off the suction device, could be influenced by manual input through the remote control by the user in that the remote control transmits a second radio signal containing information to turn on or keep turned on the suction device.

[0011] Processing or pre-processing of the received radio signal in the remote control comprises, for instance, deriving from the received second radio signal the current operation status of the hand-held electric or pneumatic power tool and generating a respective first radio signal for controlling operation of the suction device. In particular, the first radio signal serves for automatically turning on or off the suction device based on the derived current operation status of the hand-held electric or pneumatic power tool.

[0012] The first and second radio signals could be of a different format and/or standard. To this end, the processing or pre-processing by the remote control could merely comprise a transformation from a first standard of the second radio signal to a second standard of the first radio signal. This may have advantages in terms of a reduced interference of the signals and/or an increased range of the signals. Further, the remote control can serve as an interface between the signal format of the second signals transmitted by the communication device and the signal format of the first signals received by the radio receiver of the suction device. The remote control can thus achieve compatibility between the radio receiver and the communication device.

[0013] The processing or pre-processing functionality of the remote control may comprise receiving the second radio signal from the communication device, determining the current status of the hand-held power tool from the received radio signal, determining how the suction device is to be operated in order to react on the current status of the power tool and generating a respective first radio signal which is then transmitted to the suction device. Dedicated operation of the suction device in order to react on the current status of the power tool may comprise one or more of the following:

- activation of the suction device if the current status of the power tool comprises turning on the tool,
- deactivation of the suction device if the current status of the power tool comprises turning off the tool, possibly with a time delay in respect to the turning-off of the tool,
- increase of the speed of a motor of the suction device if the current status of the power tool comprises an increase of the speed of the motor of the tool,
- decrease of the speed of a motor of the suction device if the current status of the power tool comprises a decrease of the speed of the motor of the tool,
- increase of the speed of a motor of the suction device if the current status of the power tool comprises an increase of the amount of dust in the dust laden air conveyed from the air outlet of the tool and flowing through the suction hose, and
- decrease of the speed of a motor of the suction device if the current status of the power tool comprises a decrease of the amount of dust in the dust laden air conveyed from the air outlet of the tool and flowing through the suction hose,
- activation of the suction device or an increase of the speed of the motor of the suction device if the current status of the power tool comprises the use of the tool as a sanding tool,
- deactivation of the suction device or a decrease of the speed of the motor of the suction device if the current status of the power tool comprises the use of the tool as a polishing tool.

[0014] Using the remote control as an intermediate processing or pre-processing unit has the advantage that the radio signal transmitted between the communication device and the radio receiver of the suction device can be further modified by means of the remote control, for instance manually by a user of the power tool, if the remote control is provided with appropriate actuating means, control means or the like. In particular, the user may modify the first radio signal by means of the remote control before its transmission to the suction device. By modifying the first radio signal, the operation status of the suction device may be varied.

[0015] To this end, it may be possible to manually turn on and off the suction device by providing the remote control with respective actuating means. Additionally or alternatively, the remote control could be provided with respective control means for manually controlling specific functions of the suction device. The specific functions of the suction device can comprise, for instance,

- setting a speed of a motor of the suction device,
- in a suction device with a plurality of motors, activating or deactivating one or more of the motors,
- in a suction device with a plurality of motors, switching from at least one motor to at least another motor, and
- temporarily switching into a filter cleaning mode for cleaning one or more air filter elements of the suction

device, for instance by means or an inversion of the air flow through the one or more filter elements.

[0016] Preferably, the remote control is designed such that manually turning on or off the suction device based on a manual actuation of the actuating means by an operator or user of the hand-held electric or pneumatic power tool overrules automatically turning on or off the suction device depending on the derived current operation status of the hand-held electric or pneumatic power tool. For instance, the user may manually activate the suction device, even if the hand-held power tool is not (yet) turned on. Similarly, the user may manually deactivate the suction device, even if the power tool is (still) running.

[0017] The remote control may be a classic remote control provided with mechanical or electrical buttons, switches, or potentiometers for manually turning on and off the suction device and/or for manually controlling specific functions of the suction device. Alternatively, the remote control could also be provided with a touch screen and virtual buttons, switches, or potentiometers displayed on the screen and actuated by the user by touching respective regions of the screen, where the virtual buttons, switches, or potentiometers are displayed.

[0018] Furthermore, the remote control may comprise selecting means for manually selecting an operation mode of the remote control based on a manual actuation of the selecting means by an operator or user of the hand-held electric or pneumatic power tool, the operation mode of the remote control comprising one or more of the following:

- an automatic operation mode during which the suction device is automatically turned on or off based on the derived current operation status of the hand-held electric or pneumatic power tool,
- a manual operation mode during which the suction device is manually turned on or off depending on a manual actuation of the actuating means by an operator or user of the hand-held electric or pneumatic power tool or during which specific functions of the suction device are manually controlled depending on a manual actuation of the control means by an operator or user of the hand-held electric or pneumatic power tool, and
- an inactive operation mode in which the remote control is turned off.

[0019] It is suggested that the remote control is realized in the form of a smartphone with an appropriate computer programme application installed thereon and executable on a microprocessor of the smartphone. Execution of the computer programme application on the smartphone's microprocessor turns the smartphone into a remote control of the above mentioned kind for controlling the operation status of the suction device. To this end, it is suggested that the execution of the computer programme application causes the smartphone to receive the second radio signal from the communication device by means of a built-in radio receiver of the smartphone, to perform processing or pre-processing of the received radio signal, to generate a respective first radio signal and to transmit the first radio signal to a radio receiver of the suction device by means of a built-in radio transmitter of the smartphone. Preferably, the first radio signal and/ or the second radio signal is realized according to the Bluetooth-standard, to the ZigBee-standard, to the WiFi-standard, to the NFC-standard, or a telecommunication standard, like GSM, GPRS, EDGE, LTE, UMTS. Of course, other radio signal formats are conceivable for the first radio signal and/or the second radio signal, too. Preferably, the radio signals are provided in a short-range radio format adapted for being transmitted up to 100m, preferably up to 50m, particularly preferable up to 10m.

[0020] It is further suggested that actuating means for manually turning on or off the suction device and/or control means for manually controlling specific functions of the suction device and/or selecting means for selecting an operation mode of the remote control are realized in the form of virtual buttons or controls that are displayed on a touchscreen of the remote control when the computer programme application is executed on the microprocessor of the smartphone. The virtual buttons, switches, or potentiometers displayed on the touchscreen are actuated by the user by touching respective regions of the screen, where the virtual buttons, switches, or potentiometers are displayed. This allows a conventional smartphone to be easily turned into a remote control according to the present invention simply by loading and executing the respective software (i.e. the computer programme application). The software can also realize manually actuated actuating means, control means and switching means by means of the virtual buttons or controls.

[0021] According to another preferred embodiment, the radio receiver of the remote control is configured to receive a third radio signal emitted by the suction device and indicative of a current operation status of the suction device. The current operation status of the suction device may comprise, for instance, one or more of the following:

- a current temperature of one or more motors of the suction device,
- a current speed of one or more motors of the suction device,
- a pressure value upstream and/ or downstream of one or more air filter elements of the suction device,
- a pressure difference between a pressure value upstream and a pressure value downstream of one or more air filter elements of the suction device,
- a current flow rate through one or more air filter elements of the suction device,
- a fill level of a dust collection chamber of the suction device,
- an amount of dust in the filtered air blown out of the suction device through one or more of its air outlets,

- the size of dust particles in the filtered air blown out of the suction device through one or more of its air outlets.

[0022] In response to the received third radio signal and the respective operation status of the suction device, the current operation status of the suction device may be displayed to the user of the power tool, for instance on a display of the remote control, and/or appropriate measures may be taken manually or automatically. The appropriate measures comprise, for instance:

- initiating a temporary filter cleaning mode of the suction device, in the course of which one or more air filter elements of the suction device are cleaned and freed from dust and debris, for instance by means or an inversion of the air flow through the one or more filter elements,
- in a suction device having more than one motor, switching operation of the suction device to another motor,
- in a suction device having more than one motor, turning on or off an additional motor of the suction device in order to increase or reduce an air flow rate and suction power of the suction device,
- increasing or reducing speed of a running motor of the suction device, or
- operation of the suction device in an emergency mode, including an emergency stop of the suction device or its one or more motors, if an abnormal operation status of the suction device is detected.

[0023] In order to solve the object of the present invention, a suction device, in particular a vacuum cleaner or a dust extraction system, with the features of claim 10 is suggested. In particular, starting from the suction device of the above-identified kind, it is suggested that the suction device comprises a remote control for controlling an operation status of the suction device according to the present invention.

[0024] Finally, in order to solve the object of the present invention, a computer programme application comprising the features of claim 11 is suggested. In particular, it is suggested that the computer programme application is programmed to be executed on a microprocessor of a smartphone, in order to turn the smartphone into a remote control according to the present invention using a radio receiver and a radio transmitter already present in the smartphone. The radio receiver is used for receiving the second radio signal from the communication device attached to or forming part of the suction hose near the power tool or directly attached to or forming part of the power tool. The radio transmitter is used for transmitting the first radio signal to the radio receiver of the suction device for controlling the operation status of the suction device.

[0025] Further features and advantages of the present invention will be explained in more detail hereinafter with reference to the accompanying drawings. It is emphasized that each of the features shown in the figures may be individually important to the invention, even though not explicitly shown in the figures and/or described hereinafter. Furthermore, various features shown in the figures may be combined with each other in any possible manner, even though such a combination is not explicitly shown in the figures and/or described hereinafter. The figures show:

Fig. 1 a suction device with a remote control according to a first embodiment of the present invention;

Fig. 2 a remote control according to a second embodiment of the present invention; and

Fig. 3 a suction device with a remote control according to a third embodiment of the present invention.

[0026] Fig. 1 shows a suction device 2 according to the present invention in the form of a mobile vacuum cleaner or a mobile dust extraction system. The suction device 2 is configured to filter dust, dirt and small particles 6 from a flow 24 of dust-laden air and for collecting and temporarily storing the dust, dirt and small particles 6 in a dust collection chamber 4. In particular, the suction device 2 comprises:

- the dust collection chamber 4 configured to receive dust, dirt and small particles 6,
- a vacuum generating device 8 for generating a low pressure p_v in the dust collection chamber 4, which is lower than an ambient pressure p_0,
- a suction opening 10 in the dust collection chamber 4,
- a suction hose 12 connected at a first end 14 to the suction opening 10 and at an opposite second end 16 connected to an air outlet 18 of a hand-held electric or pneumatic power tool 20,
- at least one filter element 22 which is arranged in the air flow 24 generated by the vacuum generating device 8 and between the dust collection chamber 4 and the vacuum generating device 8 and which is configured to filter dust, dirt and small particles 6 out of the air flow 24,
- a control device (or electronic control unit) 26 configured to control the vacuum generating device 8 in order to turn the vacuum generating device 8 on or off depending on an operating status of the hand-held electric or pneumatic power tool 20 to whose air outlet 18 the second end 16 of the suction hose 12 is connected, and
- a radio receiver 28 for receiving first radio signals 30, the radio receiver 28 being in operative connection with the control device 26.

[0027] A communication device 32 is located at or near the second end 16 of the suction hose 12. Alternatively, the communication device 32 may be located at or near the power tool 20. The communication device 32 comprises:

- a sensor element 34 for detecting a current operation status of the hand-held electric or pneumatic power tool 20 and for outputting a sensor signal 36 indicative of the operating status of the power tool 20,
- a radio transmitter 38 for transmitting a second radio signal 54, and
- a processing device 40 which is in operative connection with the sensor element 34 on the one hand and with the radio transmitter 38 on the other hand and which is configured to cause the radio transmitter 38 to emit the second radio signal 54 depending on the sensor signal 36 received from the sensor element 34 and indicative of the current operation status of the power tool 20.

[0028] In general, the power tool 20 could be any electric or pneumatic power tool which during its intended use creates a certain amount of dust, dirt or other small particles. The power tool 20 has an electric or pneumatic motor 80 for operating its working element 82. In the embodiment shown in Fig. 1, the power tool 20 is a sanding tool and the working element 82 is a backing plate. A sanding medium 84 (e.g. an abrasive paper or fabric, an abrasive pad or the like) may be releasably attached to a bottom surface of the backing plate 82, for instance by means of a Velcro®-or an adhesion connection. Depending on the type of sanding tool, the backing plate 82 performs a purely rotational, a random orbital, an orbital or a roto orbital (gear-driven) working movement.

[0029] The power tool 20 may be equipped with a self-generated dust extraction functionality realized by means of a fan 86 which is preferably driven by the motor 80. The fan 86 creates an internal air flow 46 which conveys dust, dirt and small particles from the working area 78 of the sanding tool 20 towards the air outlet 18. Alternatively, the power tool 20 may not have a self-generated dust extraction functionality, in which case the dust, dirt and small particles from the working area 78 are sucked towards the air outlet 18 by means of the air flow 24, 46 created by the suction device 2.

[0030] Furthermore, the suction device 2 comprises a remote control 50 configured to control an operation status of the suction device 2. The remote control 50 comprises a radio transmitter 88 for transmitting the first radio signal 30 to the suction device 2 in order to turn on or off the suction device 2 or its vacuum generating device 8, respectively. The remote control 50 further comprises a radio receiver 90 configured to receive the second radio signal 54 from the communication device 32. As previously mentioned, the second radio signal 54 is indicative of the current operation status of the power tool 20. The second radio signal 54 is transmitted by the communication device 32 by means of its radio transmitter 38. The remote control 50 is configured to derive from the received second radio signal 54 the current operation status of the hand-held electric or pneumatic power tool 20. This is preferably achieved by means of a computer programme application 108 executed on a microprocessor 92 of the remote control 50. The remote control 50 is further configured to generate a respective first radio signal 30 for automatically turning on or off the suction device 2 or its vacuum generating device 8, respectively. The first radio signal 30 is generated depending on the derived current operation status of the hand-held electric or pneumatic power tool 20.

[0031] By connecting the second end 16 of the suction hose 12 to the power tool 20, the operation status of the power tool 20 can be easily and reliably determined by the sensor element 34 of the communication device 32, even if the power tool 20 itself works without electricity and/or has no means whatsoever to determine its current operation status and transfer the determined operation status to a radio receiver 28 of a suction device 2.

[0032] The sensor element 34 for detecting the operation status of the power tool 20 may be embodied in many different ways. According to preferred embodiments, the sensor element 34 is designed as an acceleration sensor for detecting vibrations of the suction hose 12 during operation of the hand-held electric or pneumatic power tool 20 or as a flow sensor for detecting an air flow 46 in the second end 16 of the suction hose 12, which is attached to the air outlet 18 of the power tool 20, during operation of the power tool 20. An operation of the power tool 20 will inevitably lead to vibrations, which may be detected by the acceleration sensor. This is in particular the case for oscillating power tools 20, e.g. a random-orbital sander, a gear-driven sander, an orbital sander or the like. The acceleration sensor may be in the form of a piezoelectric accelerometer. If the power tool 20 is provided with a self-generated dust extraction functionality, operation of the power tool 20 will inevitably lead to an air flow 46 of possibly dust-laden air from the working area 78 through the air outlet 18 of the power tool 20 and the second end 16 of the suction hose 12. This air flow 46 may be detected by a flow sensor. The flow sensor preferably has a measuring probe positioned in the air flow 46. The flow sensor may detect the air flow 46 optically, by means of ultra-sonic waves or other types of electromagnetic waves.

[0033] Alternatively or additionally, the sensor element 34 could also comprise an optical or other type of sensor for detecting an amount of dust and of other small particles contained in the dust laden air flow 46 passing through the second end 16 of the suction hose 12. Preferably, the sensor element 34 determines the amount of dust or other small particles per time unit. A status message containing or indicative of the determined amount of dust or small particles, preferably per time unit, could be contained in the sensor signal 36 and could be transmitted by the radio transmitter 38 through the second

radio signal 54 to the radio receiver 90 of the remote control 50. The rotational speed of the vacuum generating device 8 could be increased or decreased according to the determined amount of dust or small particles.

[0034] The current operation status of the power tool 2 is transmitted to the remote control 50 via the second radio signal 54. The operation status of the power tool 20 will be taken into account during generating of the first radio signal 30 and, consequently, for controlling the operation of the vacuum generating device 8 of the suction device 2. Optionally, further parameters may be taken into account for the control of the vacuum generating device 8. For example, further operation parameters of the hand-held electric or pneumatic power tool 20 (e.g. time of continuous operation since last stop; accumulated time of operation since last replacement of sanding medium 84; temperature of the electronics (e.g. an electronic control unit) of the power tool 20; state of charge of a battery of the power tool 20, amount of dust generated by the power tool 20 per time unit during its current operation) or of the suction device 2 (e.g. accumulated time of operation since last replacement of filter element 22, pressure values p_v, p_{in} on both sides of the filter element 22 (seen in the direction of the air flow 24, 60 through the filter element 22) or a respective differential pressure p_{in} - p_v), environmental parameters and parameters of the workpiece to be worked by the hand-held electric or pneumatic power tool 20.

[0035] The further operation parameters of the power tool 20 are preferably also transmitted via the second radio signal 54 from the radio transmitter 38 of the communication device 32 and the radio receiver 90 of the remote control 50. Of course, the further operation parameters of the power tool 20 could also be transmitted to the radio receiver 90 of the remote control 50 via a different radio signal transmitted by a different radio transmitter (not shown) preferably making part of the power tool 20.

[0036] The environmental parameters may be acquired by respective sensors (not shown) making part of the suction device 2 and/or the power tool 20. The parameters of the workpiece may be entered manually by a user of the power tool 20 or of the suction device 2, for example, by means of a user interface (not shown) of the power tool 20 or of the suction device 2. The user interface may comprise a touchscreen of a GUI and/or buttons or keys and/or a computer mouse or the like. Alternatively, the parameters of the workpiece may be entered manually by a user by means of the remote control 50.

[0037] The further operation parameters of the suction device 2 may be acquired by respective sensors (not shown) making part of the suction device 2. The acquired operation parameters may be considered directly by the control device 26 for the control of the suction device 2. Alternatively, the acquired operation parameters of the suction device 2 may be transmitted to the radio receiver 90 of the remote control via a radio signal transmitted from a radio transmitter (not shown) making part of the suction device 2. The remote control 50 will then consider the further operation parameters of the suction device 2 when generating the first radio signal 30 for controlling the suction device 2 or its vacuum generating device 8, respectively.

[0038] The dust collection chamber 4 may be formed by a bottom part 56 of an external housing of the suction device 2. Preferably, the dust collection chamber 4 is made of a plastic material. The dust collection chamber 4 may be provided with external wheels 58 in order to assure mobility and allow manoeuvring of the suction device 2 to its intended location of use.

[0039] If a low pressure p_v or vacuum is generated inside the dust collection chamber 4 by means of the vacuum generating device 8, the differential pressure between the low pressure p_v and the environmental pressure p_0 creates the air flow 24, which is sucked into the collection container 4 through the chamber's suction opening 10. The air flow 24 may carry dust and other small particles from the working area of the power tool 20. The dust laden air flow 24 is further sucked through the at least one filter element 22 towards the vacuum generating device 8. The at least one filter element 22 separates dust and particles 6 from the dust laden air flow 24 so that a clean air flow 60 is obtained. The vacuum generating device 8 discards the filtered clean air flow 60 into the environment through respective one or more air outlet openings 62 in another part 64, for example a top part, of the external housing of the suction device 2 in which the dust generating device 8 is housed. The bottom part 56 and the top part 64 of the external housing of the suction device 2 may be separated from each other along a plane 66 extending horizontally. Preferably, the at least one filter element 22 is attached to the top part 64 of the external housing.

[0040] Although only one filter element 22 is shown in Fig. 1, the suction device 2 may have more than one filter element 22. The one or more filter element 22 can be subject to a temporary cleaning step by reverse flushing one or more selected filter elements 22 with a clean air flow 60 in a direction opposite to the direction of the dust laden air flow 24. During the cleaning step the intended use of the suction device 2 can be maintained by operating those filter elements 22 currently not subject to the cleaning step in a normal manner (with the dust-laden air flow 24 penetrating them).

[0041] The vacuum generating device 8 may comprise one or more motors 68 which drive one or more turbines 70 for generating an air flow 24, 60 from the dust collection chamber 4 into the environment and passing through the at least one filter element 22, thereby creating the low pressure p_v in the dust collection chamber 4. The one or more motors 68 of the vacuum generating device 8 are preferably electric motors, in particular of the brushless type. The electric motors 68 can be provided with electric energy from a mains power supply (not shown) to which the suction device 2 is connected by means of an electric cable. Alternatively, the electric motor 68 could

be provided with electric energy from one or more batteries (not shown), which may be housed in the external housing 56, 64 of the suction device 2 or attached thereto.

[0042] However, the one or more motors 68 could also comprise a pneumatic motor actuated by compressed air. In order to generate electric current for the control of certain features of the suction device 2 (e.g. the control of electromagnetic valves for varying the airflow 24, 60 through the suction device 2, the operation of the electric control device 26, etc.), an electric generator or dynamo actuated by the pneumatic motor could be provided in the suction device 2.

[0043] The suction hose 12 has an elongated intermediate section 72 which is preferably flexible and made of a plastic material or metal. The suction hose 12 extends along a longitudinal axis. The intermediate section 72 is preferably corrugated in order to enhance its flexibility when bending it about a bending axis extending essentially perpendicular to the longitudinal axis of the hose 12 and for improving its stability and resilience against external forces acting on the intermediate section 72 in a direction essentially radial to the longitudinal axis 74 of the hose 12.

[0044] The first and second ends 14, 16 of the suction hose 12 preferably have a rigid structure and are attached to the elongated intermediate section 72. In particular, at least one of the rigid end pieces 14, 16 of the hose 12 is attached to the elongated intermediate section 72 in a manner freely rotatable about the longitudinal axis of the hose 12 in respect to the intermediate section 72. The first and second end pieces 14, 16 may be made of a plastic material or metal. The first end 14 of the suction hose 12 is attached to the chamber's suction opening 10, and the second end 16 is attached to the air outlet 18 of the hand held power tool 20. By connecting the air outlet 18 of the power tool 20 to the chamber's suction opening 10 through the suction hose 12, the low pressure p_v in the dust collection chamber 4 generates the air flow 24 from the air outlet 18 through the suction hose 12 into the dust collection chamber 4. The air flow 24 at the air outlet 18 creates a low pressure p_w at the working area 78 of the power tool 20, which provokes that dirt, dust and small particles are drawn away from the working area 78 by the air flow 46 and sucked up by the suction device 2 and filtered out of the dust laden air flow 24 by the at least one filter element 22 of the suction device 2.

[0045] Attachment of the first and second end pieces 14, 16 of the suction hose 12 to the suction opening 10 of the collection container 4 and to the air outlet 18 of the power tool 20, respectively, can be realized by means of a plug-in connection. The first and second end pieces 14, 16 can be held in place in respect to the suction opening 10 and/or the air outlet 18, respectively, by means of friction, a snap-in connection, a bayonet connection, magnetic force or the like.

[0046] It is suggested that the processing device 40 of the communication device 32 is adapted to cause the radio transmitter 38 to emit the second radio signal 54 when the power tool 20 changes from a turned-off to a turned-on operating status, and that the control device 26 of the suction device 2 is adapted to switch on the vacuum generating device 8 when the radio receiver 28 receives the respective first radio signal 30 from the remote control 50 and optionally taking into account further parameters. Additionally or alternatively, it is suggested that the processing device 40 of the communication device 32 is adapted to cause the radio transmitter 38 to emit the second radio signal 54 when the power tool 20 changes from a turned-on to a turned-off operating status, and that the control device 26 of the suction device 2 is adapted to switch off the vacuum generating device 8 of the suction device 2 when the radio receiver 28 receives the radio signal 30 and optionally taking into account further parameters.

[0047] Turning off of the vacuum generating device 8 may occur with a deliberate time delay in respect to the deactivation of the power tool 20. The time delay may be achieved in the remote control 50 (e.g. in the remote control 50 transmitting the first radio signal 30 only after a certain time delay in respect to the reception of the second radio signal 54 has passed, and in the suction device 2 activating the vacuum generating device 8 almost immediately after receipt of the first radio signal 30 by the radio receiver 28) or in the suction device 2 or the control device 26, respectively (e.g. in the remote control 50 the first radio signal 30 is transmitted almost immediately after receipt of the second radio signal 54, and in the suction device 2 the vacuum generating device 8 is activated only after a time delay after receipt of the first radio signal 30 by the radio receiver 28 has passed) or in the communication device 32 (e.g. the processing device 40 transmits the radio signal 54 only after a time delay has passed after detection of an operation status change of the power tool 2 by means of the sensor element 34). The time delay may be in the region of one to a few tens of seconds.

[0048] To this end it is suggested that the processing device 40 of the communication device 32 is adapted to take into account as a further parameter, when causing the radio transmitter 38 to transmit a radio signal 30, a time delay between the reception of the sensor signal 36 from the sensor element 34 and the transmission of the radio signal 30 by the radio transmitter 38. Additionally or alternatively, it is suggested that the control device 26 of the suction device 2 is adapted to take into account as a further parameter, when switching on or switching off the vacuum generating device 8, a time delay between the reception of the radio signal 30 by the radio receiver 28 and the switching on or switching off of the vacuum generating device 8.

[0049] It is suggested that the communication device 32 comprises an independent, local power supply unit 42 for providing electricity for operation of the electric components (e.g. sensor element 34, radio transmitter 38, processing device 40, user interface 50) of the communication device 32. The power supply unit 42 may

comprise a rechargeable and/or replaceable battery. The power supply unit 42 could also comprise an energy transformation device, which transforms vibrations of the second end 16 of the suction hose 12 caused by the vibrating power tool 20 during its intended use into electric energy which is supplied to the battery for recharging (energy harvesting from mechanical movements) or directly to the electric components of the communication device 32. Alternatively, the energy transformation device may comprise a pneumatic generator located in the air stream 46 through the second end 16 of the suction hose 12 which will generate electric energy once the power tool 20 with a self-generated dust extraction functionality is activated and an air stream 46 is created.

[0050] Due to the fact that the communication device 32 may be configured to transmit a radio signal 54 only occasionally when the operation status of the power tool 20 changes, the power supply unit 42 has an almost infinite lifetime without running out of electric energy. To this end, the energy transformation device may comprise piezoelectric materials, may be in the form of an electrodynamic or inductive generator or may be in the form of an electrostatic generator.

[0051] The suction device 2 may have a main switch 48 for manually switching the suction device 2 between an operational status (I) and an inactive status (0).

[0052] The radio signals 30 and 54 can be transmitted according to different parameters (e.g. frequency, channel, etc.) and standards (e.g. size and format of transmitted data packets and data frames, repetition rate of data frames, etc.).

[0053] The remote control 50 performs a processing or pre-processing of the received radio signal 54 comprising, for instance, deriving from the received second radio signal 54 the current operation status of the hand-held electric or pneumatic power tool 20 and generating a respective first radio signal 30 for controlling operation of the suction device 2. In particular, the first radio signal 30 serves for automatically turning on or off the suction device 2 based on the derived current operation status of the hand-held electric or pneumatic power tool 2.

[0054] In particular, the processing or pre-processing functionality of the remote control 50 may comprise receiving the second radio signal 54 from the communication device 32, determining the current status of the hand-held power tool 20 from the received radio signal 54, determining how the suction device 2 is to be operated in order to react on the current status of the power tool 20 and generating a respective first radio signal 30 which is then transmitted to the suction device 2. Dedicated operation of the suction device 2 in order to react on the current status of the power tool 20 may comprise one or more of the following:

- activation of the suction device 2 or its vacuum generation device 8 or its motor 68, respectively, if the current status of the power tool 20 changes from a turned off to a turned on status,
- deactivation of the suction device 2 or its vacuum generation device 8 or its motor 68, respectively, if the current status of the power tool 20 changes from a turned on to a turned off status,
- increase of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises an increase of the speed of the motor 80 of the tool 20,
- decrease of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises a decrease of the speed of the motor 80 of the tool 20,
- increase of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises an increase of the amount of dust in the dust laden air flow 46 conveyed from the air outlet 18 of the tool 20 and flowing through the suction hose 12, and
- decrease of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises a decrease of the amount of dust in the dust laden air flow 46 conveyed from the air outlet 18 of the tool 20 and flowing through the suction hose 12,
- activation of the suction device 2 or its vacuum generation device 8 or its motor 68, respectively, or increase of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises the use of the tool as a sanding tool (see Fig. 1) or as any other tool generating a certain amount of dust during its intended use,
- deactivation of the suction device 2 or its vacuum generation device 8 or its motor 68, respectively, or decrease of the speed of the motor 68 of the suction device 2 if the current status of the power tool 20 comprises the use of the tool as a polishing tool or as any other tool generating very little or no dust during its intended use.

[0055] Using the remote control 50 as an intermediate processing or pre-processing unit has the advantage that the radio signals 54, 30 transmitted between the communication device 32 and the radio receiver 28 of the suction device 2 can be further modified by means of the remote control 50, for instance manually by a user of the power tool 20, if the remote control 50 is provided with appropriate actuating means 94, control means 96 (see Fig. 2) or the like, or automatically by applying a time delay to at least one of the signals 54, 30. In particular, the user may modify the first radio signal 30 by means of the remote control 50 before its transmission to the suction device 2. By modifying the first radio signal 30, the operation status of the suction device 2 may be varied.

[0056] To this end, it may be possible to manually turn on and off the suction device 2 or its vacuum generation device 8 or its motor 68, respectively, by providing the remote control 50 with respective actuating means 94.

The remote control 50 according to the example of Fig. 1 is provided with a first push button 94a for turning on ("I") the suction device 2 and with a second push button 94b for turning off ("O") the suction device 2.

[0057] As shown in Fig. 2, additionally or alternatively, the remote control 50 could be provided with respective control means 96 for manually controlling specific functions of the suction device 2. The remote control 50 according to the example of Fig. 2 is provided with a turn switch 96 by means of which, the speed of the motor 68 of the suction device 2 can be varied between "0%" and "100%". Apart from varying the speed of the motor 68, other specific functions of the suction device 2 adjustable by the control means 96 can comprise, for instance,

- in a suction device 2 with a plurality of motors 68, activating or deactivating one or more of the motors 68,
- in a suction device 2 with a plurality of motors 68, switching from at least one motor 68 to at least another motor 68, and
- temporarily switching the suction device 2 into a filter cleaning mode for cleaning one or more air filter elements 22 of the suction device 2, for instance by means of an inversion of the air flow 24 through the one or more filter elements 22.

[0058] Preferably, the remote control 50 is designed such that manually turning on or off the suction device 2 or of the vacuum generation device 8 or of the motor 68, respectively, based on a manual actuation of the actuating means 94 by an operator or user of the hand-held electric or pneumatic power tool 20 overrules automatically turning on or off the suction device 2 depending on the derived current operation status of the hand-held electric or pneumatic power tool 20. For instance, the user may manually activate the suction device 2, even if the hand-held power tool 20 is not (yet) turned on. Similarly, the user may manually deactivate the suction device 2, even if the power tool 20 is (still) running.

[0059] As shown in Figs. 1 and 2, the remote control 50 may be a classic remote control provided with actuating means 94 (e.g. mechanical or electrical buttons, switches, or potentiometers) for manually turning on and off the suction device 2 and/or with control means 96 for manually controlling specific functions of the suction device 2. Alternatively, as shown in Fig. 3, the remote control 50 could also be provided with a touch screen 100 and virtual actuating means 102 and/or control means 104 (e.g. virtual buttons, switches, or potentiometers represented by "1", "2", "3") displayed on the screen 100 and actuated by the user by touching respective regions of the screen 100, where the virtual actuating means 102 and/or control means 104 are displayed.

[0060] Furthermore, the remote control 50 may comprise selecting means 106 (see Figs. 2 and 3) for manually selecting an operation mode of the remote control 50 based on a manual actuation of the selecting means 106 by an operator or user of the hand-held electric or pneumatic power tool 20. In particular, the operation mode of the remote control 50 can be selected among one or more of the following:

- an automatic operation mode ("A") during which the suction device 2 is automatically turned on or off based on the derived current operation status of the hand-held electric or pneumatic power tool 20,
- a manual operation mode ("M") during which the suction device 2 is manually turned on or off depending on a manual actuation of the actuating means 94, 102 by an operator or user of the hand-held electric or pneumatic power tool 20 or during which specific functions of the suction device 2 are manually controlled depending on a manual actuation of the control means 96, 104 by an operator or user of the hand-held electric or pneumatic power tool 20, and
- an inactive operation mode ("O") in which the remote control 50 is turned off.

[0061] It is suggested that the remote control 50 is realized in the form of a smartphone (see Fig. 3) with an appropriate computer programme application 108 installed thereon and executable on a microprocessor 92 of the smartphone. Execution of the computer programme application 108 on the smartphone's microprocessor 92 turns a conventional smartphone into a remote control 50 of the above mentioned kind for controlling the operation status of the suction device 2. To this end, it is suggested that the execution of the computer programme application 108 causes the smartphone to receive the second radio signal 54 from the communication device 32 by means of a built-in radio receiver 90 of the smartphone, to perform processing or pre-processing of the received radio signal 54, to generate a respective first radio signal 30 and to transmit the first radio signal 30 to a radio receiver 28 of the suction device 2 by means of a built-in radio transmitter 88 of the smartphone. Preferably, the first radio signal 30 and/ or the second radio signal 54 is realized according to the Bluetooth-standard, to the ZigBee-standard, to the WiFi-standard, to the NFC-standard, or any telecommunication standard, like GSM, GPRS, EDGE, LTE, UMTS. Of course, other radio signal formats are conceivable for the first radio signal 30 and/or the second radio signal 54, too. Preferably, the radio signals 30, 54 are provided in a short-range radio format adapted for being transmitted up to 100m, preferably up to 50m, particularly preferable up to 10m.

[0062] The radio receiver 90 of the remote control 50 may further be configured to receive a third radio signal 110 emitted by the suction device 2 and indicative of a current operation status of the suction device 2. The current operation status of the suction device 2 may comprise, for instance, one or more of the following:

- a current temperature of one or more motors 68 of the suction device 2,

- a current speed of one or more motors 68 of the suction device 2,
- a pressure value upstream (p_{in}) and/ or downstream (p_v) of one or more air filter elements 22 of the suction device 2,
- a pressure difference (p_{in} - p_v) between a pressure value upstream (p_{in}) and a pressure value downstream (p_v) of one or more air filter elements 22 of the suction device 2,
- a current flow rate through one or more air filter elements 22 of the suction device 2,
- a fill level of the dust collection chamber 4 of the suction device 2,
- an amount of dust in the filtered clean air flow 60 blown out of the suction device 2 through one or more of its air outlet openings 62,
- the size of dust particles 6 in the filtered clean air flow 60 blown out of the suction device 2 through one or more of its air outlet openings 62.

[0063] In response to the received third radio signal 110 indicative of the operation status of the suction device 2, the current operation status of the suction device 2 may be displayed to the user of the power tool 10, for instance on the display 100 of the remote control 50 and/or on a display 112 of the power tool 20 and/or on a display 114 of the suction device 2. Additionally or alternatively, in response to the received third radio signal 110, appropriate measures may be taken manually or automatically. The appropriate measures, which may be taken, comprise for instance:

- initiating a temporary filter cleaning mode of the suction device 2, in the course of which one or more air filter elements 22 of the suction device 2 are cleaned and freed from dust and debris 6, for instance by means or an inversion of the air flow 24 through the one or more filter elements 22,
- in a suction device 2 having more than one motor 68, switching operation of the suction device 2 to another motor 68,
- in a suction device 2 having more than one motor 68, turning on or off an additional motor 68 of the suction device 2 in order to increase or reduce an air flow rate through the at least one filter element 22 and suction power of the suction device 2,
- increasing or reducing speed of a running motor 68 of the suction device 2, or
- operation of the suction device 2 in an emergency mode, including an emergency stop of the suction device 2 or its one or more motors 68, if an abnormal operation status of the suction device 2 is detected.

[0064] These measures may be taken by the remote control 50 after having processed the third radio signal 110 by means of the first radio signal 30 transmitted from the radio transmitter 88 of the remote control 50 to the radio receiver 28 of the suction device 2. The first radio signal 30 may be used for transmitting the respective information to the suction device 2, causing the control device 26 of the suction device 2 to take the respective measures.

Claims

1. Remote control (50) adapted for controlling an operation status of a suction device (2), in particular a vacuum cleaner or a dust extraction system, the remote control (50) comprising a radio transmitter (88) for transmitting a first radio signal (30) to the suction device (2) for turning on or off the suction device (2),

   characterized in that
   the remote control (50) further comprises a radio receiver (90) for receiving a second radio signal (54) from a communication device (32) located at or near a second end (16) of a suction hose (12), which is connected to a suction opening (10) of the suction device (2) with its first end (14) and to an air outlet (18) of a hand-held electric or pneumatic power tool (20) with its opposite second end (16), or located at the hand-held electric or pneumatic power tool (20) itself,
   the communication device (32) adapted for detecting a current operation status of the hand-held electric or pneumatic power tool (20) and for emitting the second radio signal (54) indicative of the current operation status of the hand-held electric or pneumatic power tool (20), and
   in that
   the remote control (50) is adapted for deriving from the received second radio signal (54) the current operation status of the hand-held electric or pneumatic power tool (20) and to transmit a respective first radio signal (30) in order to automatically turn on or off the suction device (2) depending on the derived current operation status of the hand-held electric or pneumatic power tool (20).

2. Remote control (50) according to claim 1, wherein the remote control (50) further comprises actuating means (94; 102) for manually turning on or off the suction device (2) based on a manual actuation of the actuating means (94; 102) by an operator or user of the hand-held electric or pneumatic power tool (20), wherein actuation of the actuating means (94; 102) provokes the transmission of a respective first radio signal (30) to the suction device (2) through the radio transmitter (88) thereby turning on or off the suction device (2).

3. Remote control (50) according to claim 2, wherein the remote control (50) is designed such that manually turning on or off the suction device (2) based

on a manual actuation of the actuating means (94; 102) by an operator or user of the hand-held electric or pneumatic power tool (20) overrules automatically turning on or off the suction device (2) depending on the derived current operation status of the hand-held electric or pneumatic power tool (20).

4. Remote control (50) according to one or more of the preceding claims, wherein the remote control (50) comprises control means (96; 104) for manually controlling specific functions of the suction device (2) based on a manual actuation of the control means (96; 104) by an operator or user of the hand-held electric or pneumatic power tool (20).

5. Remote control (50) according to claim 4, wherein the specific functions of the suction device (2) comprise one or more of the following:

- setting a speed of a motor (68) of the suction device (2),
- in a suction device (2) with a plurality of motors (68), activating or deactivating one or more of the motors (68),
- in a suction device (2) with a plurality of motors (68), switching from at least one motor (68) to at least another motor (68), and
- temporarily switching into a filter cleaning mode for cleaning one or more air filter elements (22) of the suction device (2).

6. Remote control (50) according to one or more of the preceding claims, wherein the remote control (50) further comprises selecting means (106) for manually selecting an operation mode of the remote control (50) based on a manual actuation of the selecting means (106) by an operator or user of the hand-held electric or pneumatic power tool (20).

7. Remote control (50) according to claim 6, wherein, the operation mode of the remote control (50) comprises one or more of the following:

- an automatic operation mode ("A") during which the suction device (2) is automatically turned on or off based on the derived current operation status of the hand-held electric or pneumatic power tool (20),
- a manual operation mode ("M") during which the suction device (2) is manually turned on or off depending on a manual actuation of the actuating means (94; 102) by an operator or user of the hand-held electric or pneumatic power tool (20) or during which specific functions of the suction device (2) are manually controlled depending on a manual actuation of the control means (96; 104) by an operator or user of the hand-held electric or pneumatic power tool (20), and
- an inactive operation mode ("O") in which the remote control (50) is turned off.

8. Remote control (50) according to one or more of the preceding claims, wherein the remote control (50) has a microprocessor (92) with a computer programme application (108) executable on the microprocessor (92) for realizing the remote control functionality.

9. Remote control (50) according to one or more of the preceding claims, wherein the remote control (50) is realized in the form of a smartphone.

10. Remote control according to claim 9, wherein actuating means (102) for manually turning on or off the suction device (2) and/or control means (104) for manually controlling specific functions of the suction device (2) and/or selecting means (106) for selecting an operation mode of the remote control (50) are realized in the form of virtual buttons or controls that are displayed on a screen (100) of the smartphone when a computer programme application (108) is executed on a microprocessor (92) of the smartphone.

11. Remote control (50) according to one or more of the preceding claims, wherein the first radio signal (30) and/ or the second radio signal (54) is realized according to the Bluetooth-standard, to the ZigBee-standard, to the WiFi-standard, to the NFC-standard, or a telecommunication standard, like GSM, GPRS, EDGE, LTE, UMTS.

12. Remote control (50) according to one or more of the preceding claims, wherein the radio receiver (90) of the remote control (50) is adapted for receiving a third radio signal (110) from the suction device (2) indicative of a current operation status of the suction device (2).

13. Remote control according to claim 12, wherein the current operation status of the suction device (2) comprises one or more of the following:

- a current fill level of a dust collection chamber (4) of the suction device (2),
- a current flow rate through one or more air filter elements (22) of the suction device (2),
- in a suction device (2) with a plurality of motors (68), the number of and/or information on which motor (68) is currently activated,
- a current speed of a motor (68) of the suction device (2), and
- a current temperature of a motor (68) of the suction device (2).

14. Suction device (2), in particular a vacuum cleaner or

a dust extraction system, comprising a remote control (50) for controlling an operation status of the suction device (2),

characterized in that
the remote control (50) for controlling an operation status of the suction device (2) is a remote control according to one or more of the preceding claims.

15. Computer programme application (108) executable on a microprocessor (92) of a smartphone, the computer programme application (108) being programmed in order to turn the smartphone into a remote control (50) according to one or more of the claims 1 to 13 using a built-in radio transmitter (88) and possibly also a built-in radio receiver (90) already present in the smartphone.

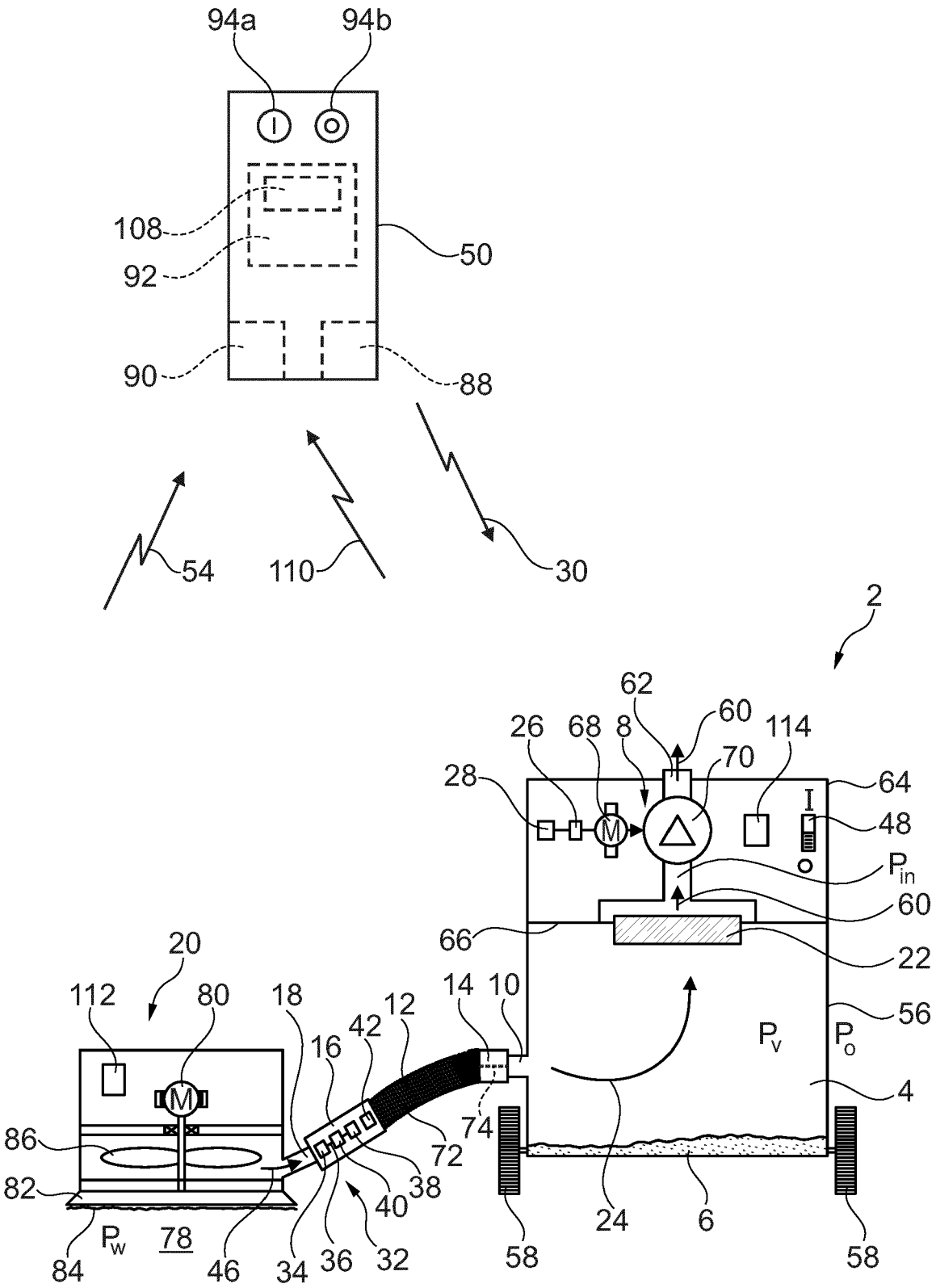
94a
94b
108
92
50
90
88
54
110
30
2
62
60
26
68
8
114
70
28
64
48
P_{in}
60
66
22
20
112
80
18
12
14
10
42
16
56
P_v
P_o
4
74
86
72
38
82
40
24
6
P_w
78
84
46
34
36
32
58
58

Fig. 1

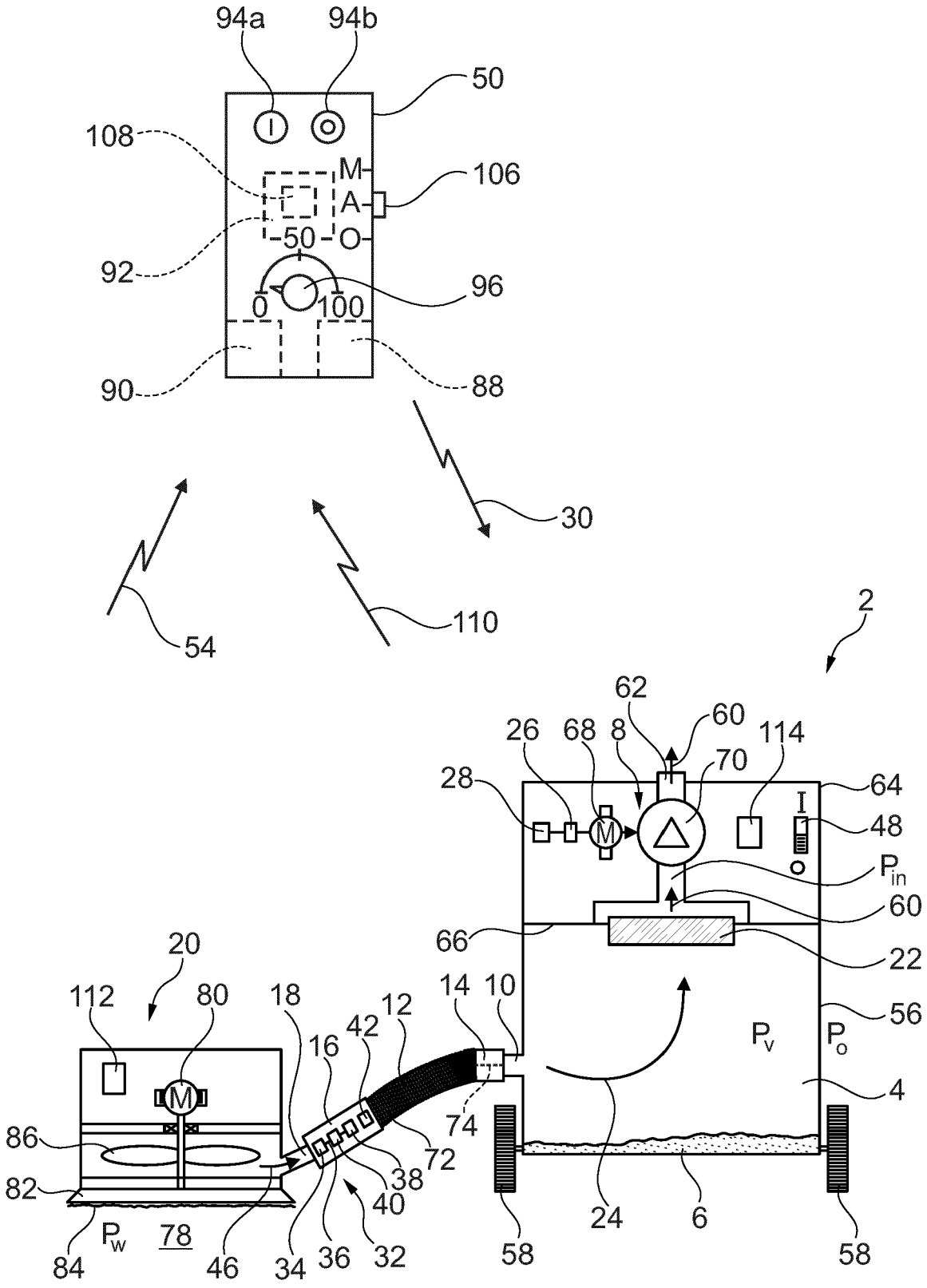
94a
94b
50
108
M
A
106
50
O
92
96
0
100
90
88
30
54
110
2
62
26
68
8
60
114
28
70
64
I
48
P_{in}
60
66
22
20
112
80
18
14
10
12
42
16
56
P_v
P_o
4
74
86
72
38
40
82
24
6
P_w
78
84
46
34
36
32
58
58

Fig. 2

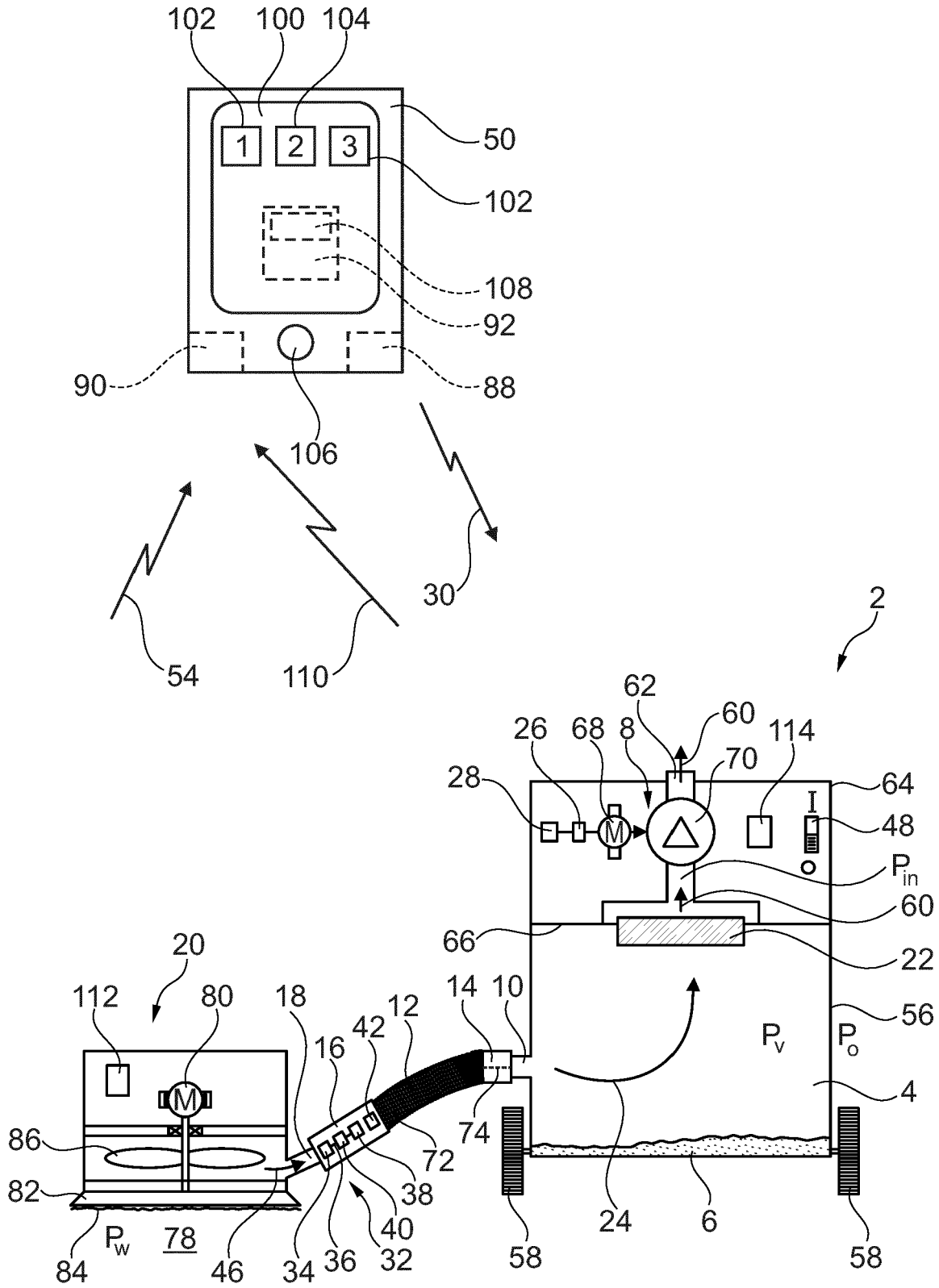
102
100
104
1
2
3
50
102
108
92
90
88
106
30
54
110
2
62
60
26
68
8
114
70
28
64
I
48
M
P_{in}
60
66
22
20
112
80
18
12
14
10
56
42
16
P_v
P_o
4
M
74
86
72
38
82
40
24
6
P_w
78
84
46
34
36
32
58
58

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 19 7230

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 100 767 124 B1 (JEONG TAE WOONG [KR]) 12 October 2007 (2007-10-12) * the whole document *	1-4,6, 8-12,14, 15	INV. A47L9/28 A47L11/40 A47L7/00
X	DE 10 2018 210682 A1 (BOSCH GMBH ROBERT [DE]) 2 January 2020 (2020-01-02) * paragraph [0043] - paragraph [0061]; figures 1,3 *	1-4,6,8, 11,14,15	
X	EP 2 080 467 A2 (BLACK & DECKER INC [US]) 22 July 2009 (2009-07-22) * paragraph [0020] - paragraph [0028]; figures 1-7 *	1-4,6,8, 11,14,15	
X	DE 10 2017 131457 A1 (FESTOOL GMBH [DE]) 13 December 2018 (2018-12-13)	1	
A	* Modularaufnahme (96) als Fernbedienung; paragraph [0192] *	2-15	
			TECHNICAL FIELDS SEARCHED (IPC) A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 March 2023	Trimarchi, Roberto

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 19 7230

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-03-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 100767124 B1	12-10-2007	NONE	
DE 102018210682 A1	02-01-2020	CN 112601481 A	02-04-2021
		DE 102018210682 A1	02-01-2020
		EP 3813622 A1	05-05-2021
		US 2021353121 A1	18-11-2021
		WO 2020002029 A1	02-01-2020
EP 2080467 A2	22-07-2009	EP 2080467 A2	22-07-2009
		US 2009183336 A1	23-07-2009
DE 102017131457 A1	13-12-2018	CN 110785794 A	11-02-2020
		DE 102017131457 A1	13-12-2018
		EP 3635703 A1	15-04-2020
		JP 7158417 B2	21-10-2022
		JP 2020522921 A	30-07-2020
		JP 2022169583 A	09-11-2022
		KR 20200018434 A	19-02-2020
		US 2020101574 A1	02-04-2020
		WO 2018224626 A1	13-12-2018

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 21175076 A **[0005] [0009]**