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(54) Title: IMPROVED MANNER OF CONTROLLING BATTERY OPERATED FORESTRY OR GARDEN RELATED TOOL

(57) Abstract: A system, method and power tool, comprising a tool arranged to acquire settings, and in response thereto adapt the operation of the tool based on the settings. Said system further comprises a power source that is arranged to acquire settings and transfer settings to the tool, whereby the tool is configured to adapt its operation. Said system further comprises a tag that is arranged to provide settings based on which the tool is arranged to adapt its operation. The settings comprise an indication of charging and discharging level. The battery level of the power tool is monitored and when the charging level is reached the charging is inactivated, at least temporarily, and when the discharging level is reached the tool is at least temporarily inoperable. The settings are associated with an operator, work task, expected speed of completion and/or maintenance interval and the tool is a lawnmower, trimmer, hedge cutter, garden shearer, leaf blower or chain saw.
IMPROVED MANNER OF CONTROLLING BATTERY OPERATED FORESTRY OR GARDEN RELATED TOOL

TECHNICAL FIELD

This application relates to a method and a battery operated power tool for increasing the lifetime of a battery and in particular to a method for and a battery operated power tool for increasing the lifetime of a battery by providing settings for the battery operated power tool.

BACKGROUND

Battery powered or operated power tools are becoming more and more widespread. Also some systems allow for one and the same (type of) battery to be used with multiple battery operated power tools. Furthermore, as many battery operated power tools are used in different ways, such as with regards to operating time and in different working environment, they are also subjected to different wear and tear. Also, different fleet owners (someone who manages a large collection of working tools) may have different desires or aims with his working tools. One may favour speed of completion, whereas another may favour robustness and less maintenance.

There is as such a discrepancy in how a battery operated power tool should be used which is difficult if not impossible for a manufacturer to foresee.

There is thus a need for an improved manner of adapting a battery operated power tool according to different working environments and aims.

Also, the batteries will be subject to many different use situations and be charged many times which will decrease the life time of the batteries.

Examples of battery operated power tools include, but are not limited to lawnmowers, trimmers, hedge cutters shears, leaf blowers and chain saws.

There is thus a need for an improved manner of extending the lifetime of the batteries when being used by different operators and possibly different battery operated power tools.
SUMMARY

It is an object of the teachings of this application to overcome the problems listed above by providing a user interface, settings of a battery operated power tool and the corresponding battery may be adapted in order to provide for a longer lifetime of the battery by ensuring that the battery is not charged unnecessarily. This is achieved by providing a

It is also an object of the teachings of this application to overcome the problems listed above by providing a battery operated power tool configured to acquire settings, which settings comprise an indication of an operation parameter, wherein the operation parameters may relate to a charging level, an output power, a operation efficiency, a speed of a working implement, an acceleration of a working implement, and to operate the battery operated power tool according to the settings.

In one embodiment the battery operated power tool is configured to acquire settings, which settings comprise an indication of a charging level and a discharging level; and to operate the battery operated power tool according to the settings by monitoring a battery level of the battery and if the battery level reaches the discharge level render the battery operated power tool at least temporarily inoperable, and if the battery level reaches the charging level inactivate any charging at least temporarily.

It is also an object of the teachings of this application to overcome the problems listed above by providing a method for controlling a battery operated power tool arranged to be powered by a battery, wherein the method comprises: acquiring settings, which settings comprise an indication of a charging level and a discharging level; and operating the battery operated power tool according to the settings by monitoring a battery level of the battery and if the battery level reaches the discharge level render the battery operated power tool at least temporarily inoperable, and if the battery level reaches the charging level inactivate any charging at least temporarily.

It is also an object of the teachings of this application to overcome the problems listed above by providing a charger configured to acquire settings, which settings comprise an indication of an operation parameter, wherein the operation parameters may relate to a charging level and to operate the charger according to the settings.
In one embodiment the charger is arranged to be connected to a battery, wherein the charger is configured to acquire settings, which settings comprise an indication of a charging level; and to operate the charger according to the settings by monitoring a battery level of the battery and if the battery level reaches the charging level inactivate any charging at least temporarily.

It is also an object of the teachings of this application to overcome the problems listed above by providing a method for controlling a charger arranged to be connected to a battery, wherein the method comprises acquiring settings, which settings comprise an indication of a charging level; and operating the charger according to the settings by monitoring a battery level of the battery and if the battery level reaches the charging level inactivating any charging at least temporarily.

It is also an object of the teachings of this application to overcome the problems listed above by providing a tag comprising a memory for storing data relevant to settings and an interface for receiving and transmitting said data relevant to settings through.

It is also an object of the teachings of this application to overcome the problems listed above by providing a system comprising a tag according to herein and a battery operated power tool according to herein and/or a charger according to herein.

In one embodiment the system comprises a tool arranged to acquire settings, and in response thereto adapt the operation of the tool based on the settings.

In one embodiment the system further comprises a power source that is arranged to acquire settings and transfer said settings to the tool, whereby the tool is configured to adapt its operation.

In one embodiment the system further comprises a charger that is arranged to acquire settings and in response thereto adapt its operation.

In addition, the teachings herein provides for optimization of the battery operated power tool using a set of operating parameters to adapt to various user needs with respect to the trade-off between performance, user experience, maintenance needs and lifetime.

Other features and advantages of the disclosed embodiments will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings. Generally, all terms used in the claims are to be interpreted according to their ordinary meaning.
in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the
[element, device, component, means, step, etc]" are to be interpreted openly as referring to at
least one instance of the element, device, component, means, step, etc., unless explicitly stated
otherwise. The steps of any method disclosed herein do not have to be performed in the exact
order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in further detail under reference to the
accompanying drawings in which:

Figure 1 shows an illustration of a system according to an example embodiment.

Figure 2 shows a corresponding flowchart for a method according to an example
embodiment

Figure 3A shows an example of a battery operated power tool according to one
embodiment of the teachings herein;

Figure 3B shows a schematic view of a battery operated power tool according to one
embodiment of the teachings herein;

Figure 3C shows a schematic view of a control panel for a battery operated power
tool according to one embodiment of the teachings herein;

Figure 3D shows a schematic view of a charger for a battery to be used with a
battery operated power tool according to one embodiment of the teachings herein;

Figure 4A and 4B each shows schematic time graphs for a battery level.

Figure 5 shows an illustration of a system according to an example embodiment; and

Figure 6 shows a corresponding flowchart for a method according to an example
embodiment.

DETAILED DESCRIPTION

The disclosed embodiments will now be described more fully hereinafter
with reference to the accompanying drawings, in which certain embodiments of the
invention are shown. This invention may, however, be embodied in many different
forms and should not be construed as limited to the embodiments set forth herein;
rather, these embodiments are provided by way of examples so that this disclosure will
be thorough and complete, and will fully convey the scope of the invention to those
skilled in the art. Like numbers refer to like elements throughout.

It should be noted that all indications of rotational speeds, time durations, work
loads, battery levels, operational levels et.c. are given as examples and may be varied in many
different ways as would be apparent to a skilled person. The variations may be for individual
entities as well as for groups of entities and may be absolute or relative.

Figure 1 shows a schematic overview of a system according to the teachings herein.
An improved tool management system 100 is focused on a tool 1, such as an electric or
combustion powered power tool. The tool is a garden or forestry related tool such as a
lawnmower, trimmer, hedge cutter, garden shearer, leaf blower or chain saw to mention a few
examples.

The teachings herein are especially useful for outdoor garden or forestry tools such
as trimmers and chainsaws as these are often subjected to highly varying working conditions
and tasks and thus benefits from an adaptability as provided herein. Furthermore, the teachings
herein find particular use with tools with interchangeable working implements or power sources.
The following description will focus on an electric tool in the form of a trimmer, but should be
understood not to be limited to an electric trimmer.

The tool 1 may comprise a controller (referenced CPU in figure 3B) and a computer
readable memory, such as a solid state memory, a Read Only Memory and/or a Random Access
Memory (referenced MEM in figure 3B), as well as an interface (referenced INTERFACE in
figure 3B) for interfacing communication with a device (such as a battery) for transfer of
operation parameters or other settings. As would be understood, the choice or combination of
memory can be made in many different ways. Also, the controller may be chosen to be
implemented as one or as several processors, possibly distributed. The interface may be wired or
wireless (such as through a Bluetooth® or similar connection). The interface may be formed by
the charging contacts of the battery or from specific contacts provided as interface contacts.
Again, many variations of how to connect one device to another exist and will not be explored
in detail in this application. The tool 1 may be connected for communication to a power source
or to a tag 11 or both - or to an external device such as a computer or other data processing
apparatus capable of providing operation parameters. The tool 1 may thus receive operation parameters directly or through another device.

In one embodiment, the tool 1 is arranged to receive operating parameters through a user interface (referenced 8 in figure 3A). In such an embodiment, an owner or the operator may adjust the operating parameters of the tool 1 based on the working conditions and requirement it will be subjected to during the next working session(s).

The operation parameters may include, but are not limited to, the power usage, the speed of the motor (/engine), the rotating or working speed of the working implement (the chain for a chainsaw and the trim line or trim disc for a trimmer), acceleration of the working implement, or the charging levels for a power source, such as a battery.

The tool 1 may thus be arranged to store operation parameters in the memory MEM. In one example, that of figure 1, the tool 1 carries information on the maximum output power allowed, the trigger response and the load response. The memory may hold a default value and a current, possibly user edited value. The parameters may be given as absolute values (1 kW for example), as relative values (0-100 %) or as preset threshold or typical values (Low, Medium, High).

As mentioned, the tool 1 is operably connected to a power source, in this example a battery 4. The battery 4 may comprise a controller (referenced CPU in figure 3A) and a computer readable memory, such as a solid state memory, a Read Only Memory and/or a Random Access Memory (referenced MEM in figure 3A), as well as an interface (referenced INT in figure 3A) for interfacing communication with the tool 1 (or a tag 11) for transfer of operation parameters. As would be understood, the choice or combination of memory can be made in many different ways. Also, the controller may be chosen to be implemented as one or as several processors, possibly distributed. The interface may be wired or wireless (such as through a Bluetooth® or similar connection). The interface may be formed by the charging contacts of the battery or from specific contacts provided as interface contacts. Again, many variations of how to connect one device to another exist and will not be explored in detail in this application. The battery 4 may be connected for communication to the tool 1 or to a tag 11 or both - or to an external device such as a computer or other data processing apparatus capable of providing
operation parameters. The battery 4 may thus receive operation parameters directly or through the tool 1.

The operator may further be provided with a tag 11 which may also be arranged to carry operating parameters that are provided to the tool 1 and/or to the power source 4. The tag may be provided with operating parameters which may then be transferred to a tool 1 or battery 4 for adapting the operation of the tool. The function and use of the tag will be detailed in greater detail in the main example given below.

A charger 7, a service tool and/or an external device may also be adapted and/or used to provide operating parameters to the tool 1 (or the battery 4). By providing all the necessary components in a charger, a battery may be charged according to the teachings herein also when in a separate charger. By enabling the adaptation of the charging to be done also in the charger, a battery array may be charged even when not being connected to the battery operated power tool.

As can be seen in figure 3D a a schematic view of a charger is shown, the charger 7 comprising an interface for receiving operating parameters and a controller for adapting the operating parameters and/or the charging according to the operating parameters, and to provide the operating parameters to the battery when such is connected. The operation is thus arranged

An owner may thus adapt a fleet of working tools depending on a) what task it is to perform, b) the working conditions, c) the operator intended to use the tool 1 and also d) the condition of the tool 1. The operation may be adapted to correspond to operation targets relating to speed of completion, maintenance required, wear and tear posed on the tool 1, operating costs, time to next/from previous service to mention a few examples.

Having a system 100 such as disclosed herein, where the operation of a tool 1 may be adapted by providing owner specified parameters, either directly or indirectly, is thus highly beneficial in that allows for customized adaptation based on any number of parameters.

Furthermore, as more than one device in the system may be arranged to carry operating parameters, the total operation parameters for a tool may be distributed among several other devices, thereby facilitating the storage and maintenance (such as updating) of all possible operating parameters. For example, if one type of battery is arranged with one set of operating parameters, and another type of batteries is arranged with another set of parameters, the tool
manufacturer need not store the parameters for the respective battery types. Likewise, if one type of tool is provided with one set of operating parameters and another type of tool is provided with another set of operating parameters, the battery manufacturer need not store information on all different types of tools.

In the context of the system disclosed herein, an owner may then further customize such settings to his own desires and needs. Should the owner update part of his tool fleet, the updated tools will automatically be adapted according to the operating parameters carried by the various devices.

This is especially useful when an owner wants to adapt the operation of his business, whereby his whole fleet may be adapted in a corresponding manner and to the owner's preference when it comes to speed of completion or other parameters as discussed above.

The system 100 disclosed herein may thus be seen as a system to provide a distributed data storage for a device/tool depending on which battery/external device/implement is being used. Such a system also provides a degree of redundancy in that should one storage become damaged or lost, all operation parameters are not lost.

Figure 2 shows a flowchart for a general method for use in such a system, wherein a tool acquires 210 settings. The settings may be acquired through an internal query 212, directly 214 from user or indirectly 218 from another device having received or been provided with, that is acquired 216, the parameters, and adapts its operation 220 accordingly.

The settings may be associated with an owner or an operator of the battery powered tool 1 or the owner, such that for example a tool fleet owner may alter the settings in accordance with specific parameters associated with operators, tasks or locations, ambient light intensity/daylight, clock time etc.

In addition, the settings may be associated with a parameter of the battery powered tool (1) such as a total time of operation of the battery powered tool 1 or the time in operation lapsed after a maintenance of the battery powered tool 1. Thus, the battery powered tool 1 may adapt operating setting such as a maximum output power level, operating efficiency, maximum speed of a working implement in accordance with any parameter.

In further embodiments the settings may be associated with the battery operated power tool 1 itself to enable tool-specific settings whereby the battery 4 is arranged to adapt its
operation based on the tool-specific settings. The tool-specific settings, which may be a tool-specific parameter may comprise priorities, for example prolonged operation time of the battery powered tool 1 and/or the battery 4 may be prioritized over efficiency of the battery operated power tool 1 or vice versa by adapting or limiting a maximum allowed output power level, a speed of a working implement.

In one exemplary embodiment the settings may comprise a trade-off between longevity / operating hours of the battery operated power tool 1 and/or battery 4 versus performance / output power of the battery operated power tool and/or the battery 4.

In a further exemplary embodiment, wherein the settings are associated with a working task, an operator, an expected time of completion, a pre-determined duration of a working task, the battery operated power tool 1 or the battery 4 may adapt its operation to operate according to the settings and allow a output power level depending on a task duration or pre-determined time of operation. Such settings may be independent priorities of the battery operated tool 1. For example, to allow a high output power level provided the task is associated with a short duration of operation.

The settings may be associated with an operating parameter associated with an ambient temperature, an operating temperature of the battery operated power tool, ambient light intensity, a location and the battery operated power tool 1 or the battery 4 may according to one embodiment adapt its operation to operate according to the settings by suspending a setting rendering the battery operated power tool at least temporarily inoperable in response to an operating temperature or a motor temperature and/or limit a output power level of the battery operated power tool 1 and/or the battery 4 in response to an ambient temperature, an operating temperature or a motor temperature. According to further embodiments the battery operated power tool may adapt its operation according to a parameter associated with ambient light of the battery operated power tool by adjusting a noise level, a speed of a working implement according to the settings.

The battery operated power tool may comprise a trigger for controlling an acceleration of a working implement, a speed of a working implement, an acceleration of a working implement, a output power of the battery, a output power of the battery operated power tool. The trigger may comprise a potentiometer or like regulating resistor, a digital controller, a
circuit switch or like wherein the settings may be associated with a parameter such as an operator, a task or a location as has been described herein. The trigger may provide a speed of implement target value and/or an acceleration of working implement target value. The settings may comprise a ratio or relation between a position of the trigger, speed of implement target value, an acceleration of working implement target value and a maximum speed of a working implement, a maximum output power of the battery, a maximum output power of the battery operated power tool, a maximum output power of the battery 4. For example, the battery operated power tool may adapt its operation to according to the settings by limiting the maximum speed of a working implement, a maximum output power of the battery, a maximum output power of the battery operated power tool, a maximum output power of the battery 4 in accordance with the operator associated with the settings and operating the battery operated power tool 1.

A working implement may comprise, including but not limited to a motor of the battery operated working tool and cutting tools the battery operated working tool including scissors, shearers, fans, cutting edges or the like appreciated by a person skilled in the art.

In the example below, an example of such a system will be provided focused on adapting the charging levels of a tool. The same teachings may be applied to adapt other parameters, such as speed, acceleration, output power, boost mode power level, boost rpm level, duration for boost, charging current level, to name a few examples. For the Example of configurable charging levels, the actual charging levels used depends on the type of battery to be charged and providing an exhaustive list would be unnecessarily as a skilled person would understand what charging levels would be suitable. Examples may be however, to charge using 50%, 75%, 80%, 85%, 90% 105% or 110% of the recommended charging level, or any value in between these examples, the examples thus also serving as borders for possible ranges.

A specific example of how a parameter may be adapted according to the teachings herein will now be exemplified focused on the example of adapting the charging levels.

Figure 3A illustrates a perspective view of a battery operated power tool, in this example an electric trimmer 1 of an example embodiment. Even though only an electric trimmer 1 is shown as an example of a battery operated power tool, it should be noted that the teachings herein may also be applied to other battery operated power tools such as lawnmowers, trimmers,
hedge cutters, garden shearers, leaf blowers or chain saws, to name a few examples. The trimmer comprises a power source 4, which is a battery providing electrical power to an electric motor 2 arranged to power an operating tool 10, in this example a trimmer head 10, being one example. The trimmer head 10 comprises or is arranged to be attached to a cutting disc or trimmer line.

The trimmer 1 further comprises at least one handle 5 and a pole 6 on which the power supply 4 (most likely in a housing of the trimmer 1), the motor 2 and the trimmer head 10 are arranged. The battery may be an internal battery or an external battery as per figure 3A.

The motor 2 may be arranged adjacent the trimmer head 10 or adjacent the power supply 4. For balancing purposes and power transmission reasons the motor 2 is arranged adjacent the trimmer head 10 in the example of figure 3A.

Arranged adjacent to (or on) the at least one handle 5 is a control panel 8 comprising one or more buttons, such as a speed control, start button and/or a button for initiating the automated trimmer line feed. For example, the control panel 8 may comprise a dead-man's-hand switch (to be depressed by the palm of a user's hand when holding the grip 5), a throttle control switch (to be actuated by the user's fingers) and a feed line button (possibly arranged as a thumb control button), among other controls such as for changing the power level, changing the rotational direction to mention a few examples. The control panel may also comprise visual indicators such as LEDs (Light Emitting Diodes) for indicating a status of the trimmer 1.

Optionally the trimmer 1 also comprises a radio frequency receiver (RF) or sensor 9 for sensing the presence of a radio frequency tag and also for receiving an identity of the radio frequency tag. The radio frequency receiver 3 may be configured to operate according to a radio frequency communication standard such as RFID or NFC (near Field Communication) to mention a few examples.

The RF receiver 9 and the control panel may be seen as making up an interface 8/9 for controlling the trimmer 1 either manually or through radio frequency communication, thereby also allowing machine to machine type communication and control of the trimmer 1.

As an alternative to (or in addition to) the interface 9 may be wired, such as through a Universal Serial Bus (USB) interface.
Figure 3A also shows a tag 11 which may be arranged to communicate with the battery operated power tool 1. The tag 11 is also shown in an enlarged schematic view and the tag 11 comprises a memory MEM and a radio frequency interface RF. The tag is configured to retrieve data stored in the memory MEM and communicate this through the RF interface. The tag 11 may also be arranged to receive data through the RF interface and store it for later retrieval in the memory MEM. The tag 11 may thus be arranged to communicate both with a battery operated power tool 1 and another device, such as a computer (more on this below with reference to figure 3). As an alternative to (or in addition to) the interface 9 may be wired, such as through a Universal Serial Bus (USB) interface.

Figure 3A also shows a charger 7, being part of the battery tool system comprising the battery operated power tool 1 and the battery 4. The charger may in one embodiment, as discussed below, comprise a memory for storing settings, and also an interface (wired or radio frequency) for receiving or sending such settings. The charger 7 may also be used to charge the battery even when not connected in the battery operated power tool. More details on this will be given below with reference to figure 3D, but the operation is similar to that of the battery operated power tool when charging the battery.

Figure 3B shows a schematic view of a battery operated power tool, such as the trimmer 1 of figure 1A wherein a controller CPU is connected to the motor 2 for controlling the operation of the motor2. The motor 2 in turn being connected to an operating head, such as the trimmer head 10 for driving the trimmer head 10. The controller CPU is arranged to receive inputs such as through the command panel 8 or through the RF receiver 9, that is through the interface for affecting the operation of the motor 2 and thereby the operation of the trimmer 1. The controller CPU may also be connected to the power source, such as to the battery 4. By identifying the power source and the remaining battery level the controller CPU may change or control the operation of the trimmer 10 especially with regards to charging and discharging of the battery 4.

The controller CPU may also be connected to the motor 2 and/or to the trimmer head 10 for receiving input, such as the load on the drive shaft and/or the current rotational speed, based on which the controller CPU may change or control the operation of the trimmer.
The controller may be arranged in the battery operated power tool 1, the battery 4 or distributed to both the battery operated power tool 1 and the battery 4 for controlling respective parts of the manner disclosed herein.

The inventors have further realised that by only allowing a battery operated power tool to discharge down to a specific discharge level, the life time of the battery may be extended. Similarly, by only allowing a battery operated power tool to charge up to a specific charge level, the life time of the battery may also be extended.

Figure 4A shows an exemplary time-current graph for the charge level of a battery operated power tool over time. At the beginning, the charge level is at a maximum and as the battery operated power tool is used, the charge level is reduced gradually. As a lower discharge level DL is reached, the battery operated power tool is configured to render itself inoperable as if the battery was depleted. Whether the battery operated power tool signals this in the same manner as a proper battery depletion or not may vary. For example, there may be an override allowing the discharge level to be passed, at least partially, by for example 10% to enable a work task to be finished.

As the discharge level DL is reached, the battery operated power tool 1 should be charged again (after a little time has passed, or directly if plugged in to an electric power source). As the battery operated power tool 1, or rather the battery 4 of the battery operated power tool, is charged it is only charged up to a charging level CL.

This allows for both a faster charge and also increases the lifetime of the battery as the extreme charge levels (empty/full) of the battery is not reached.

The charging level CL and discharge level DL may be varied depending on the actual battery operated power tool and the task at hand. Furthermore, the actual levels may be handled by a processor in the battery (indicating a full charge or depleted discharge) or by a controller of the battery operated power tool or both (as has also been discussed in the above).

In one embodiment the maximum power output of the battery operated power tool 1 may also be specified by the settings along with or alternatively to the charge levels.

In one embodiment the charging current and voltage level of the charger 7 may also be specified by the settings along with or alternatively to the charge levels.
Although the charging power level may not in a real life be indicated, but the charging current and/or the charging voltage may instead be specified. For the purpose of this application, there will not be made any difference herein and they the charging power level should be understood to also possibly be a charging current and/or a charging voltage level. The choice, as a skilled person would understand, depends on the type of battery to be charged.

By allowing for settings such as charging level, discharging level, maximum charging power level and also possibly the maximum output power level the operation of a device may be adapted according to an operator's needs so that the life time of the battery 4 is extended.

The charging level and the discharge level are levels of battery charging states which indicate to what degree the battery is charged currently. 0% represents fully depleted and 100% represents fully charged.

As can be seen in figures 4A and 4B the maximum power output level and the charging power level are not the same in the two examples as is indicated by the different slopes of their corresponding curves.

Some examples of charge levels are
CL 85%, DL 15%;
CL 90%, DL 0%;
CL 85%, DL 20%; to name a few.

The charging level typically lies within the range 70% to 100%
The discharging level typically lies within the range 0% to 35%

In one embodiment, the levels are input directly through the control panel 8. Figure 1C shows a schematic view of a control panel 8. The control panel 8 comprises at least one button 8a-8d for setting or receiving the charge level and the discharge level. The charge and discharge levels may be input as numerical values indicating a relative or absolute charge/discharge level, or by using stepwise increase/decrease of the respective levels, possibly with buttons for selecting which level that is to be changed or by having different buttons for the different levels. The control panel 8 may further comprise a display device 8e, which in the example of figure 1C is an array of Light Emitting Diodes (LEDs) that indicate the current battery level. By using different colors, the available range may be indicated. For example, the
available range may be indicated by that the LEDs outside of the range having a different color. The LEDs 8e may be used to indicate the range available, or the display range of the LEDs 8e may change depending on the available range. In figure 1C, the unavailable range (i.e. the range above the charging level and below the discharge level) is indicated by crossed-out LEDs and the current level is indicated by barred boxed.

Naturally, other display means such as displays may also be used.

In one embodiment the charging levels CL, DL are associated with a code or identifier. The identifier may be associated with an operator and/or with a task to be performed. This allows for adapting a battery operated power tool 1 according to who is to use it and/or what it is to be used for. For example, if a first operator commonly works for long periods of times, he should have a large available range, whereas a second operator may have a different range available to him. Similarly a first task (mowing a lawn) may be associated with a first range, whereas a second task (cutting branches) may be associated with another range.

The charging levels may thus be associated with a code or identifier. One manner of inputting the charging levels may thus be to input the code or identifier, whereby the associated charging levels may be inputted (possibly by being retrieved from an internal memory) to the battery operated power tool 1.

As would be apparent to a skilled person there are many manners of inputting data manually to a device and also presenting the data and although only one example is shown, many more alternatives or variations are to be taken as being included in the inventive concept disclosed herein.

In one embodiment, the levels are input through the RF interface 9. As with manual input, the levels may be input directly or through their association with an identifier or code.

The battery operated power tool 1 is thus configured, in one embodiment, to receive data indicating at least one of the levels through the radio interface. The data indicating the at least one level may be an identifier or code associated with at least one level and/or at least one of the levels expressly indicated. In one such embodiment, an identifier may be provided along with a charging level to be used instead of the associated one. Some examples are shown in figure 4, where a one tag 11 is arranged to carry a charging level CL1, a discharge level DL1 and a charging power level CPL1, one tag is arranged to carry an identifier ID2, which is
associated with a charging level CL2, a discharge level DL2 and a charging power level CPL2,
and one tag is arranged to carry an identifier ID3, which is associated with a charging level CL3,
a discharge level DL3 and a charging power level CPL3, but also carries a discharge level DL3'
to be used instead of the associated discharge level DL3.

It should be noted that any of the settings such as the charging power level need not
be specified in which case default values will be used.

Figure 5 shows a system utilizing the teachings herein wherein a workstation or base
station, such as a computer, 12 is to provide identifier(s), code(s) and/or charge levels to at least
one tag lla-c. In the example three tags lla-c are shown, but the system functions with any
number of tags, which number may also vary dynamically. Also, in the example shown each tag
is provided with different settings, but they may also be provided with the same settings - at
least a portion of the tags.

The charge level settings (identifier, code and/or charging levels) are provided to the
tags through an interface, which may be a radio frequency interface or it may be a wired
interface such as a Universal Serial Bus (USB) interface, Controller area network (CAN), RS-
485, RS-232 or other single ended or differential serial communication interfaces.

A tag may comprise both a RF interface and a USB interface for example to receive
settings through the USB interface and provide them to the battery operated power tool 1
through the RF interface.

As the tag 11 has been provided with charge level settings it may be carried by an
operator to adapt a battery operated power tool to be used. One operator Oa may be given a first
tag 11a and use it with a first battery operated power tool 1a, and another operator Ob may be
given a second tag 11b and use it with a second battery operated power tool 1b, or with the same
battery operated power tool at different times. Thereby battery operated power tools may be
adapted according to an operator’s specific needs.

The settings may be transferred from the tag 11 to the battery operated power tool 1
by connecting the tag 11 and the battery operated power tool 1 through their respective
interfaces. If a wired interface is used, the tag is connected to the battery operated power tool 1
perhaps by being inserted into the battery operated power tool 1, as could be the case with a
USB interface. If a RF interface is used, the tag is connected to the battery operated power tool 1
perhaps by being placed in the vicinity of the battery operated power tool 1, as could be the case with a NFC interface.

In figure 5 the tags 11 are shown to be carried by the operator O in such a position that the tag 11 is close to the battery operated power tool 1. For use with NFC having an effective range of less than a meter, which in most cases is enough for operating the battery operated power tool while carrying the tag 11.

The battery operated power tool 1 may also be configured to only work if a tag 11 is connected to it. In such an embodiment, the tags 11 may thus be used for theft protection. In such an embodiment, the tag also carries an identifier or start code that it transmits to the battery operated power tool 1 and the battery operated power tool 1 is then configured to only operate if the identifier or code is an approved identity or code.

The computer 12 may be operated by a dealer, an employer, an operator, and/or a fleet manager.

Even if the disclosure herein has been focused on the charging levels being handled by the battery operated power tool 1 or the battery 4, in one embodiment, the charge level is stored in or input to a charger.

Figure 6 shows a flowchart for a general method according to herein, wherein a battery operated power tool 1 acquires 610 charge level settings indicating a charging level CL and a discharge level DL and possibly a charging power level and also optionally a maximum power output level, wherein at least the discharge level DL is higher than full depletion of the battery 4 and/or at least the charging level CL is lower than full charge of the battery 4. During operation the battery operated power tool 1 (or the battery 4) operates according to the settings 620 by monitoring the current battery level and as the battery level reaches 622 the discharge level DL, the battery operated power tool is rendered inoperable. As has been indicated above, the battery operated power tool 1 may be configured to go beyond the discharge level if for example a further code is provided.

During charging of the battery operated power tool 1 (or the battery 4) the charging is done at the specified charging power level 624 and the battery operated power tool 1 or the charger 7 monitors the current battery level and as the battery level reaches 626 the charging
level CL, the charging is stopped. As has been indicated above, the battery operated power tool 1 may be configured to go beyond the charge level if for example a further code is provided.

The settings may be provided by manual input 611 through a control panel, or it may be received from a tag 11 being connected 612 to the battery operated power tool 1. Naturally, the settings may be provided both through manual input and from the tag.

The settings may also be acquired form an internal memory as being default settings. The settings indicate what charge levels are to be used. As has been discussed in the above, the charge levels CL, DL and also the charging power levels, and possibly the output power level may be retrieved indirectly through an association with a code or an identifier. In one embodiment, the battery operated power tool 1 may retrieve the charge levels CL, DL from a server, possibly stored in the computer 12 through the use of a RF interface or other communication interface, such as a GSM (Global System Mobile) or LTE (Long Term Evolution) system.

In one embodiment, the settings may also indicate what power level that can be used by the battery operated power tool 1. The power level may also or additionally be associated with an identifier or a code or it may be indicated expressly.

The power level setting may thus also be used to adapt the operation of a battery operated power tool 1 according to the needs of an operator.

Other settings that may be communicated relate to acceleration rate, load response as well as the examples given in the above.

The operation of the battery operated power tool 1 may be adapted by changing set points or other variables in the software code instructions used to control the operation of the battery operated power tool 1, the charger 7 and/or the battery 4.

For the charger 7 of figure 3D, the operation is similar albeit the discharge (624) would not be made when the battery is connected to the charger 7.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.
CLAIMS

1. A system comprising a tool (1) arranged to acquire settings, and in response thereto adapt the operation of the tool (1) based on the settings, said system further comprising a power source (4) that is arranged to acquire settings and transfer said settings to the tool (1), whereby the tool (1) is configured to adapt its operation, and said system further comprising a tag (11) that is arranged to provide settings based on which the tool (1) is arranged to adapt its operation, wherein the settings comprise an indication of a charging level (CL) and a discharging level (DL); and the battery operated power tool (1) is configured to operate according to the settings by monitoring a battery level of the battery (4) and if the battery level reaches the discharge level (DL) render the battery operated power tool at least temporarily inoperable, and if the battery level reaches the charging level (DL) inactivate any charging at least temporarily, and wherein the settings are associated with an operator, a work task, an expected speed of completion, and/or a maintenance interval, and wherein the battery operated power tool (1) is a lawnmower, trimmer, hedge cutter, garden shearer, leaf blower or chain saw.

2. The system of any previous claim, further comprising a charger (7) that is arranged to acquire settings and in response thereto adapt its operation.

3. A method for use in a system comprising a tool (1), the method comprising acquiring settings, and in response thereto adapting the operation of the tool (1) based on the settings, which settings comprise an indication of a charging level (CL) and a discharging level (DL); and operate the battery operated power tool (1) according to the settings by
monitoring a battery level of the battery (4) and if the battery level reaches
the discharge level (DL) render the battery operated power tool at least temporarily
inoperable, and
if the battery level reaches the charging level (DL) inactivate any charging
at least temporarily, and wherein
the settings are associated with an operator, a work task, an expected speed
of completion, and/or a maintenance interval, and wherein
the battery operated power tool (1) is a lawnmower, trimmer, hedge cutter,
garden shearer, leaf blower or chain saw.

4. A battery operated power tool (1) configured to acquire settings, which
settings comprise an indication of an operation parameter, wherein the operation
parameters may relate to a charging level, an output power, a operation efficiency, a
speed of a working implement, an acceleration of a working implement, and to operate
the battery operated power tool (1) according to the settings, wherein the settings further
comprise an indication of a charging level (CL) and a discharging level (DL); and the
battery operated power tool (1) is configured to operate according to the settings by
monitoring a battery level of the battery (4) and if the battery level reaches
the discharge level (DL) render the battery operated power tool at least temporarily
inoperable, and
if the battery level reaches the charging level (DL) inactivate any charging
at least temporarily, and wherein
the settings are associated with an operator, a work task, an expected speed
of completion, and/or a maintenance interval, and wherein
the battery operated power tool (1) is a lawnmower, trimmer, hedge cutter,
garden shearer, leaf blower or chain saw.

5. The battery operated power tool (1) according to claim 4, wherein the
settings further comprise indications of a charging power level and wherein the battery
operated power tool (1) is configured to charge the battery (4) using the charging power
level as per the settings.
6. The battery operated power tool (1) according to claim 4 or 5, wherein
the settings further comprise indications of a output power level and wherein the battery
operated power tool (1) is configured to operate using the output power level as per the
settings.

7. The battery operated power tool (1) according to claim 4, 5 or 6, wherein
the settings are received through a radio frequency interface (9) comprised in the battery
operated power tool (1).

8. The battery operated power tool (1) according to any of claims 4 to 7, wherein the settings are received through a control panel (8) comprised in the battery
operated power tool (1).

9. The battery operated power tool (1) according to any of claims 4 to 8, wherein the settings are associated with an identifier or code, and wherein the settings
are acquired by acquiring the identifier or code.

10. A tag (11) comprising a memory (MEM) for storing data relevant to
settings and an interface (RF/USB) for receiving and transmitting said data relevant to
settings through to a battery operated tool (1) based on which settings the tool (1) is
arranged to adapt its operation, wherein
the settings comprise an indication of a charging level (CL) and a
discharging level (DL); and the battery operated power tool (1) is configured to operate
according to the settings by
monitoring a battery level of the battery (4) and if the battery level reaches
the discharge level (DL) render the battery operated power tool at least temporarily
inoperable, and
if the battery level reaches the charging level (DL) inactivate any charging
at least temporarily, and wherein
the settings are associated with an operator, a work task, an expected speed of completion, and/or a maintenance interval, and
wherein the battery operated power tool (1) is a lawnmower, trimmer, hedge cutter, garden shearer, leaf blower or chain saw.

11. The tag (11) according to claim 10, wherein the interface is a radio frequency interface, or wherein the interface is a wired interface.

12. A charger (7) configured to acquire settings, which settings comprise an indication of an operation parameter, wherein the operation parameters may relate to a charging level and to operate the charger (7) according to the settings, wherein the charger (7) is further arranged to be connected to a battery (4), and wherein the charger (7) is configured to acquire settings, which settings comprise an indication of a charging level (CL); and to operate the charger (7) according to the settings by monitoring a battery level of the battery (4) and if the battery level reaches the charging level (DL) inactivate any charging at least temporarily.

13. A system comprising a tag (11) according to any of claims 10 or 11 and a battery operated power tool (1) according to any of claims 4 to 9 and/or a charger according to claim 12.

14. The system of any preceding claim wherein the settings are associated with an operator, and the battery operated power tool (1) is configured to operate according to the settings by adjusting an output power level, an operation efficiency, an acceleration of a working implement, a speed of a working implement in accordance with said operator.

15. The system of any preceding claim wherein the settings are associated with a work task, and the battery operated power tool (1) is configured to operate
according to the settings by adjusting an output power, a speed of a working implement in accordance with said task.

16. The system of any preceding claim wherein the settings are associated with an expected speed of completion, and the battery operated power tool (1) is configured to operate according to the settings by adjusting operating efficiency, speed of a working implement, an acceleration of a working implement in accordance with said expected speed of completion.

17. The system of any preceding claim wherein the settings are associated a maintenance interval, a time-in-operation of said battery operated tool and the battery operated power tool (1) is configured to operate according to the settings by adjusting operating efficiency, speed of a working implement, an acceleration of a working implement in accordance with said time-in-operation and/or maintenance interval.

18. The system of any preceding claim wherein the settings comprise an indication of an operation parameter, wherein the operation parameters may relate to a location, and the battery operated power tool (1) is configured to operate according to the settings by adjusting operating efficiency, speed of a working implement, an acceleration of a working implement in accordance with said location.

19. The system of any preceding claim wherein the settings comprise an indication of an operation parameter, wherein the operation parameters may relate to a an ambient temperature and/or operating temperature of said battery operated tool (1) and the battery operated power tool (1) is configured to operate according to the settings by limiting an output power, a operation efficiency, a speed of a working implement, an operating temperature of the battery powered tool (1), a motor temperature of the battery powered tool (1).

20. The system of any preceding claim wherein the settings are associated said battery operated power tool (1), whereby the power source (4) is configured to
operate according to the settings by adjusting an output power level of said battery (4) in accordance with said battery operated power tool (1).

21. The system of any preceding claim wherein the settings are associated with a clock time and/or a time duration, and the battery operated power tool (1) is configured to operate according to the settings by automatically render the battery operated power tool at least temporarily inoperable, adjust a power output level and/or limit a speed of a working implement in accordance with said clock time and/or said time duration.

22. The system of any preceding claim wherein the settings are associated with an operator, and wherein said battery operated power tool (1) comprises a trigger providing a speed of implement target value and/or an acceleration of working implement target value, and the battery operated power tool (1) is configured to operate according to the settings by setting a maximum speed of a working implement and/or a maximum acceleration of a working implement in accordance with said operator.
Fig. 1
Fig. 2
Fig. 4A

Fig. 4B
Fig. 5
610 ACQUIRE SETTING

611 INPUT SETTINGS

612 TRANSMIT SETTINGS

620 OPERATE ACCORDING TO SETTINGS

622 DISCHARGE TO LOWER LEVEL

624 CHARGE USING CHARGING POWER LEVEL

626 CHARGE TO UPPER LEVEL

Fig. 6
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B25B, B25F, G08C

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

SE, DK, FI, NO classes as above

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

EPO-internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search 07-1 1-201 7

Date of mailing of the international search report 07-1 1-201 7

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International Patent Classification (IPC)

G08C 17/02 (2006.01)
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