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(71) Applicant: **Koninklijke Philips N.V.**
5656 AG Eindhoven (NL)

(72) Inventors:
- **VAN DER SCHEER, Robbert Freerk Johan**
  5656 AG Eindhoven (NL)
- **NENGERMAN, Joost Willem Frederik**
  5656 AG Eindhoven (NL)
- **KROEZEN, Arno**
  5656 AG Eindhoven (NL)

(74) Representative: **Philips Intellectual Property & Standards**
High Tech Campus 52
5656 AG Eindhoven (NL)

(54) DETERMINING WHEN AN OPERATIONAL HEAD NEEDS REPLACING

(57) The subject-matter of the present disclosure relates to a computer-implemented method of determining when an operational head (106) of a personal care appliance (100) needs to be replaced. The computer-implemented method comprises: monitoring (700) an operational parameter sensed by a sensor (114) of the personal care appliance, the operational parameter associated with operating the operational head; determining (702 values based on the operational parameter over time; determining (704) an energy used in operating the operational head over time based on the values; determining (706) that the operational head needs to be replaced based on changes of the energy over time; and sending (708) a signal indicating that the operational heads to be replaced in response to the determining that the operational head needs to be replaced.

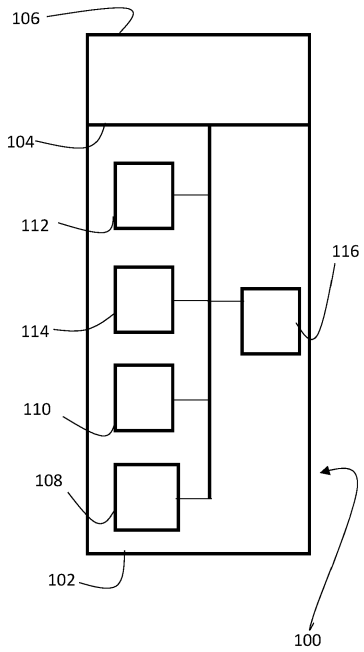

Figure 1

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Description

FIELD OF THE INVENTION

[0001] The subject-matter of the present disclosure relates to personal care appliances and determining when an operational head of a personal care appliance requires replacing, plus transitory, or non-transitory, computer-readable media.

BACKGROUND OF THE INVENTION

[0002] Personal care appliances, such as hair cutting devices, often include a cutter. The cutter, when first installed to the personal care appliance, is sharp and cuts or shaves hair well. However, over time, the cutter or shaving device becomes more blunt and requires replacing.

[0003] Generating a replacing signal for a user can be difficult because different users have different hair types. For example, one user may have a dense beard with thick hair. Another use may have a sparse beard with finer hair. The former will blunt the cutter quicker than the latter.

[0004] It is an aim of the subject-matter of the present disclosure to improve on the prior art.

SUMMARY OF THE INVENTION

[0005] According to a first aspect of the present invention, there is provided a computer-implemented method of determining when an operational head of a personal care appliance needs to be replaced, the computer-implemented method comprising: monitoring an operational parameter sensed by a sensor of the personal care appliance, the operational parameter associated with operating the operational head; determining values based on the operational parameter over time; determining an energy used in operating the operational head over time based on the values; determining that the operational head needs to be replaced based on changes of the energy over time; and sending a signal indicating that the operational heads to be replaced in response to the determining that the operational head needs to be replaced. By determining that the operational head needs replacing based on changes of the energy over time, the determination is based on how the personal care appliance operates on that specific user. In this way, the determination is tailored to the specific user.

[0006] In an embodiment, the determining the values based on the operational parameter over time comprises: measuring, using the sensor, real time values of the operational parameter; and subtracting free-running values of the operational parameter from the real time values of the operational parameter.

[0007] In an embodiment, the subtracting the real time values based on operational parameter from the free-running value of the operational parameter comprises: monitoring a real time free-running value of the operational parameter; and subtracting the real time free-running value of the operational parameter from the real time value of the operational parameter.

[0008] In an embodiment, the monitoring the real time free-running value of the operational parameter comprises determining the real time free-running value of the operational parameter by: using a low-pass filter on the real time values of the operational parameter to discard values above a threshold; calculating a moving minimum value from the real time values of the operational parameter; or calculating a moving 1st percentile value from the real time values of the operational parameter.

[0009] In an embodiment, the determining that the operational head needs to be replaced based on changes of the energy over time comprises: calculating a cumulative energy over time using the determined energy; comparing the cumulative energy to an energy threshold; and determining that the operational head needs to be replaced based on the comparison.

[0010] In an embodiment, the determining that the operational head needs to be replaced based on the comparison comprises determining that the operational head needs to be replaced when the cumulative energy is greater than or equal to the energy threshold.

[0011] In an embodiment, the personal care appliance comprises a motor for operating the operational head, in-use, and wherein the operational parameter is power or current of the motor.

[0012] In an embodiment, the determining the energy used in operating the operational head over time based on the values based on operational parameter comprises integrating the determined values over time.

[0013] In an embodiment, the personal care appliance is a trimmer or a shaver, and the operational head is a trimmer.

[0014] In an embodiment, the sending a signal indicating that the operational head is to be replaced in response to the determining that the operational head needs to be replaced comprises sending a signal to a display device to display a notification to a user to replace the operational head.

[0015] In an embodiment, the display device is a remote device, or a display device mounted to the personal care appliance.

[0016] According to an aspect of the present invention, there is provided a transitory, or non-transitory, computer-readable medium, having instructions stored thereon that when executed by one or more processors, cause the one or more processors to perform the computer-implemented method of any preceding aspect or embodiment.

[0017] According to an aspect of the present invention, there is provided a personal care appliance comprising: a handle; a sensor coupled to the handle; an attachment for attaching an operational head to the handle; and a controller having a processor and storage, wherein the storage has instructions stored thereon that, when executed

by the processor, cause the processor to perform the computer-implemented method of any preceding aspect or embodiment.

[0018] These and other aspects of the present invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The embodiments of the present inventions may be best understood with reference to the accompanying figures, in which:

Fig. 1 shows a block diagram of a personal care appliance according to one or more embodiments;
Fig. 2 shows a series of parameter values captured over time for respective new and worn operational heads of the personal care appliance;
Fig. 3 shows operational values measured from a sensor of the personal care appliance over time, and their breakdown into a component attributable to operating the operational head and a component attributable to a free-running motor of the personal care appliance, according to one or more embodiments;
Fig. 4 shows a graph for use in determining the free-running values from the measured values, according to one or more embodiments;
Fig. 5 shows a graph showing cumulative energy over a number of shaves compared to a cumulative energy replacement threshold; and
Fig. 6 shows a flow chart summarising a computer-implemented method of determining whether an operational head of a personal care appliance requires replacing.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] At least some of the example embodiments described herein may be constructed, partially or wholly, using dedicated special-purpose hardware. Terms such as 'component', 'module' or 'unit' used herein may include, but are not limited to, a hardware operational head, such as circuitry in the form of discrete or integrated components, a Field Programmable Gate Array (FPGA) or Application Specific Integrated Circuit (ASIC), which performs certain tasks or provides the associated functionality. In some embodiments, the described elements may be configured to reside on a tangible, persistent, addressable storage medium and may be configured to execute on one or more processors. These functional elements may in some embodiments include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. Although the example embodiments have been described with reference to the components, modules and units discussed herein, such functional elements may be combined into fewer elements or separated into additional elements. Various combinations of optional features have been described herein, and it will be appreciated that described features may be combined in any suitable combination. In particular, the features of any one example embodiment may be combined with features of any other embodiment, as appropriate, except where such combinations are mutually exclusive. Throughout this specification, the term "comprising" or "comprises" means including the component(s) specified but not to the exclusion of the presence of others.

[0021] With reference to Fig. 1, a personal care appliance 100 according to one or more embodiments includes a handle 102, an attachment 104, an operational head 106, a power source 108, a controller 110, a motor 112, a sensor 114, and a display 116.

[0022] The personal care appliance 100 may be a hair removal appliance such as a trimmer or a shaver, for example. The operational head 106 is a device that performs and operation, e.g. hair removal. The operational head may be a trimmer. The trimmer includes a guard and a cutter. The cutter and the guard each comprise teeth which cut hair there between when the cutter moves reciprocally over the guard.

[0023] The attachment 104 attaches the operational head 106 to the handle 102.

[0024] The power source 108 may be a battery, e.g. a secondary, or rechargeable, battery.

[0025] The controller 110 may include storage and one or more processors. The storage includes electronic data in the form of instructions. The instructions, when executed by the one or more processors, may cause the one or more processors to perform the computer-implemented methods described herein. In this way, the storage may be non-transitory computer readable media. The instructions may also be provided as transitory computer-readable media when provided as a download to be stored on the storage.

[0026] The motor 112 may consume energy from the power source 108 when operating. This energy may be sensed by the sensor 114. The sensor sensed an operational parameter associated with operating the operational head. The operational parameter being current or power.

[0027] The display 116 may be mounted to an exterior surface of the handle 102 and communicatively linked to the controller so as to display indications generated by the controller.

[0028] With reference to Fig. 2, both graphs show operational parameter values cycling between values associated with cutting hair and values associated with a free-running motor. The values of a free-running motor are associated with the troughs 202 and the values of cutting hair are associated with the peaks 204. Also shown on each graph is an average value line 206, a

value plus 10% of the average value 208, and a value minus 10% of the average value 210. The upper figure is associated with a brand-new cutter. The lower figure is associated with a worn cutter. It can be seen that the amplitude between values associated with cutting hair and values associated with a free-running motor is larger for the worn cutting element, and therefore the +10% lines 208, 210, are farther apart.

[0029] Therefore, it can be seen that the operational parameter values can be used for determining when the operational head needs replacing since there are differences between worn and brand-new cutters.

[0030] Embodiments provide a computer-implemented method of determining when an operational head of a personal care appliance requires replacing that addresses this need. The method includes monitoring an operational parameter sensed by a sensor of the personal care appliance, the operational parameter associated with operating the operational head; determining values based on the operational parameter over time; determining an energy used in operating the operational head over time based on the values; determining that the operational head needs to be replaced based on changes of the energy over time; and sending a signal indicating that the operational heads to be replaced in response to the determining that the operational head needs to be replaced.

[0031] With reference to Fig. 3, the determining the values based on, or of, the operational parameter over time for each use comprises, for each use: measuring, using the sensor, real time values of the operational parameter; and subtracting the real time values 302 of the operational parameter from a free-running value 306 of the operational parameter. The result of the subtraction is the values of the operational parameter 304.

[0032] This method is shown in Fig. 3 when the free-running value 306 is constant. This is an approximation method.

[0033] With reference to Fig. 4, a more accurate method is provided where the wherein the subtracting the real time values of the operational parameter from the free-running value of the operational parameter comprises: monitoring a real time free-running value 402 of the operational parameter; and subtracting the real time value 404 of the operational parameter from the real time free-running value of the operational parameter over time. The result of the subtraction is the real time values 406. The method associated with Fig. 4 is more accurate than the method associated with Fig. 3 because the free-running values are in real-time, i.e. they are continually updated and not assumed to be constant.

[0034] It is possible to obtain the real-time free running value 402 in various ways. For instance, it is possible to determine the real time free-running value of the operational parameter by using a low-pass filter on the real time values 404 of the operational parameter to discard values above a threshold. The threshold may be set at what is known to be a free-running value of a motor for example. Another way is to calculate a moving minimum value from the real time values of the operational parameter. The moving minimum uses a time window which moves with time. A minimum real time value 404 in the window is obtained and is used as the real-time free running value 402. Another way is to calculate a moving nth percentile value from the real time values of the operational parameter. The nth percentile may be a 1st, 2nd or even a 3rd percentile, for example, although other percentiles may be used too.

[0035] With reference to Fig. 5, the determining that the operational head needs replacing based on changes of the energy over time comprises: calculating a cumulative energy over time using the determined energy; comparing the cumulative energy to an energy threshold; and determining that the operational head needs to be replaced based on the comparison.

[0036] The determining an energy used in operating the operational head over time based on the values comprises integrating the power values over time. This is visualised as integrating an area under a curve of the values 406 in Fig. 4. This may be done numerically rather than analytically. The cumulative energy is calculated by adding energy values for each shave to a total cumulative energy, $E_{cutting\_cumulative}$, value of all shaves since the current cutter has been attached to the personal care appliance. The energy threshold, or energy replacement threshold, $E_{replace}$, may be predetermined.

[0037] As shown in Fig. 5, the time, or number of shaves, to reach the energy replacement threshold, $E_{replace}$, is less for a heavy beard than a light beard. A heavy beard is defined as a beard that is dense and/or has thick hair. A light beard is a beard that is sparse and/or has thin hair. It will be appreciated that when the cumulative energy, $E_{cutting\_cumulative,}$ is greater than or equal to the energy threshold, $E_{replace}$.

[0038] Finally, the sensing the signal indicating that the operational head needs to be replaced when the determining that the operational head needs to be replaced comprises sending a signal to the display 116 (Fig. 1) to display a notification to a user to replace the operational head. The display in Fig. 1 is a display mounted to the personal care appliance but the display may also be a display of a remote device.

[0039] With reference to Fig. 6, a computer-implemented method of determining when an operational head of a personal care appliance requires replacing is summarised as including the steps of: monitoring 700 an operational parameter sensed by a sensor of the personal care appliance, the operational parameter associated with operating the operational head; determining 702 values based on the operational parameter over time; determining 704 an energy used in operating the operational head over time based on the values; determining 706 that the operational head needs to be replaced based on changes of the energy over time; and sending 708 a signal indicating that the operational heads to be replaced in response to the determining that the opera-

tional head needs to be replaced.

[0040] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

[0041] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfil the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A computer-implemented method of determining when an operational head (106) of a personal care appliance (100) needs to be replaced, the computer-implemented method comprising:

   monitoring (700) an operational parameter sensed by a sensor (114) of the personal care appliance, the operational parameter associated with operating the operational head;
   determining (702) values based on the operational parameter over time;
   determining (704) an energy used in operating the operational head over time based on the values;
   determining (706) that the operational head needs to be replaced based on changes of the energy over time; and
   sending (708) a signal indicating that the operational heads to be replaced in response to the determining that the operational head needs to be replaced.

2. The computer-implemented method of Claim 1, wherein the determining the values (406) based on the operational parameter over time comprises:

   measuring, using the sensor, real time values (404) of the operational parameter; and
   subtracting free-running values (402) of the operational parameter from the real time values of the operational parameter.

3. The computer-implemented method of Claim 2, wherein the subtracting the real time values based on operational parameter from the free-running value of the operational parameter comprises:

   monitoring a real time free-running value of the operational parameter; and
   subtracting the real time free-running value of the operational parameter from the real time value of the operational parameter.

4. The computer-implemented method of Claim 3, wherein the monitoring the real time free-running value of the operational parameter comprises determining the real time free-running value of the operational parameter by:

   using a low-pass filter on the real time values of the operational parameter to discard values above a threshold;
   calculating a moving minimum value from the real time values of the operational parameter; or
   calculating a moving n^{th} percentile value from the real time values of the operational parameter.

5. The computer-implemented method of any preceding claim, wherein the determining that the operational head needs to be replaced based on changes of the energy over time comprises:

   calculating a cumulative energy over time using the determined energy;
   comparing the cumulative energy to an energy threshold; and
   determining that the operational head needs to be replaced based on the comparison.

6. The computer-implemented method of Claim 5, wherein the determining that the operational head needs to be replaced based on the comparison comprises determining that the operational head needs to be replaced when the cumulative energy is greater than or equal to the energy threshold.

7. The computer-implemented method of any preceding claim, wherein the personal care appliance comprises a motor (112) for operating the operational head, in-use, and wherein the operational parameter is power of the motor.

8. The computer-implemented method of Claim 7, wherein the determining an energy used in operating the operational head over time based on the values based on operational parameter comprises integrating the determined values over time.

9. The computer-implemented method of any preceding claim, wherein the personal care appliance is a shaver, and the operational head is a trimmer

10. The computer-implemented method of any preceding claim, wherein the sending a signal indicating that the operational head is to be replaced in response to the determining that the operational head needs to be replaced comprises sending a signal to a display device (116) to display a notification to a user to replace the operational head.

11. The computer-implemented method of Claim 10, wherein the display device is a remote device, or a display device mounted to the personal care appliance.

12. A transitory, or non-transitory, computer-readable medium, having instructions stored thereon that when executed by one or more processors, cause the one or more processors to perform the computer-implemented method of any preceding claim.

13. A personal care appliance (100) comprising:

a handle (102);
a sensor (114) coupled to the handle;
an attachment (104) for attaching an operational head to the handle; and
a controller (110) having a processor and storage, wherein the storage has instructions stored thereon that, when executed by the processor, cause the processor to perform the computer-implemented method of any of Claims 1 to 11.

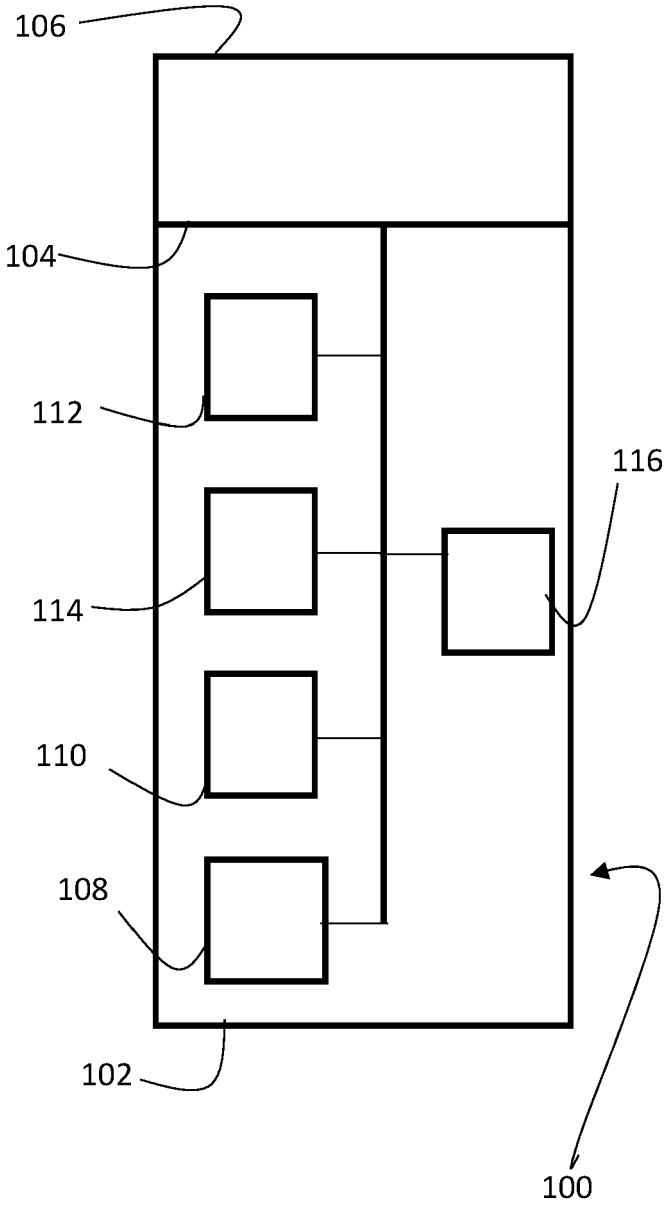

Figure 1

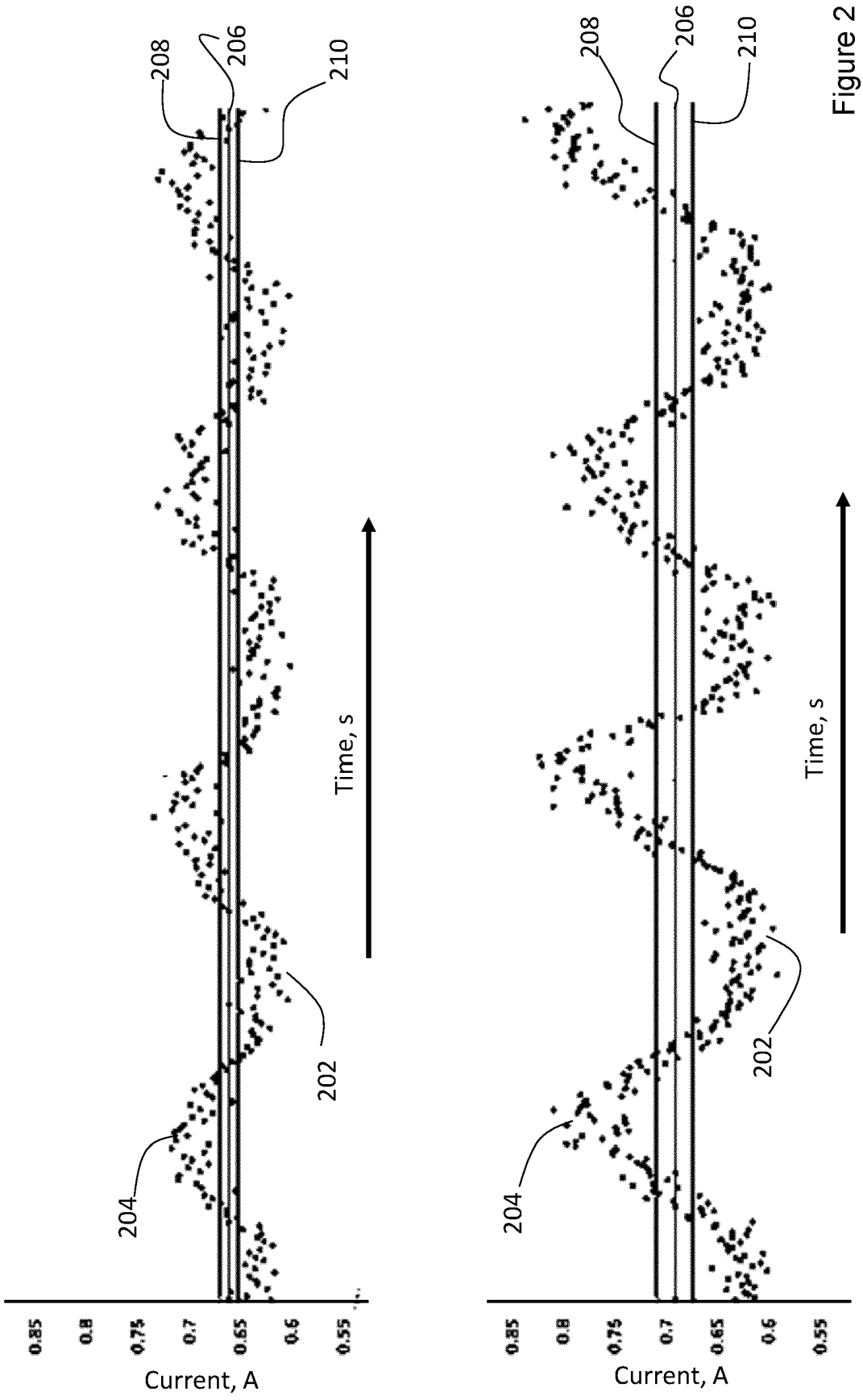

Figure 2

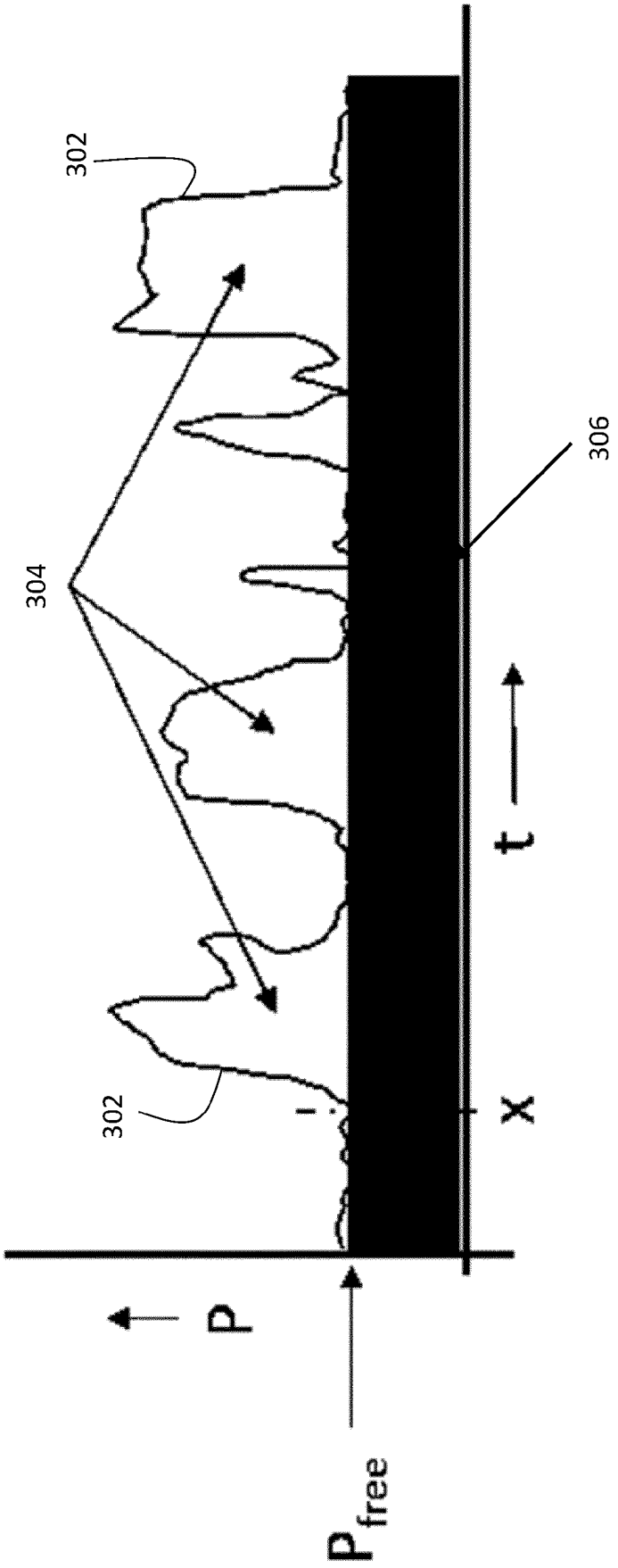

Figure 3

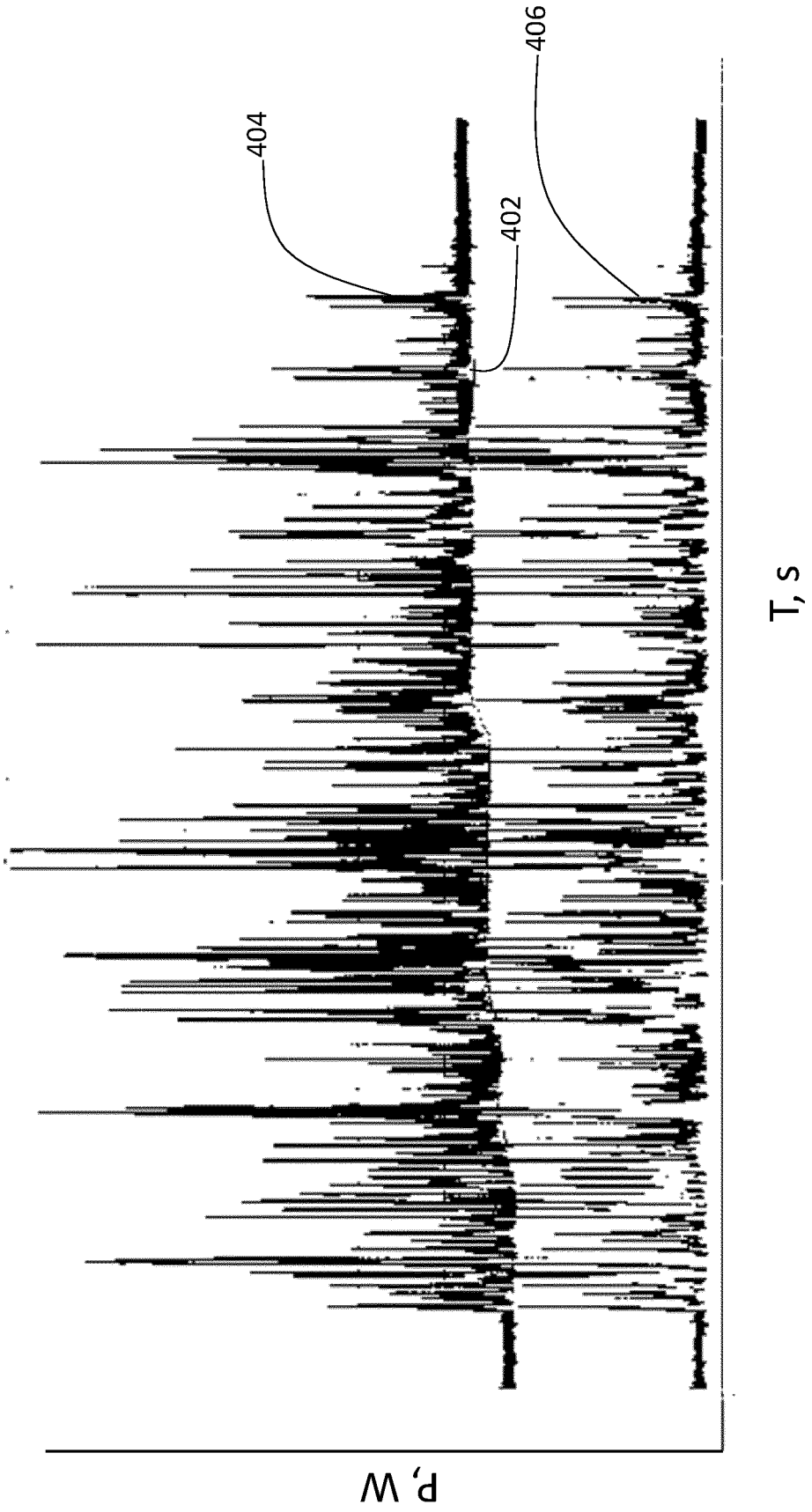

Figure 4

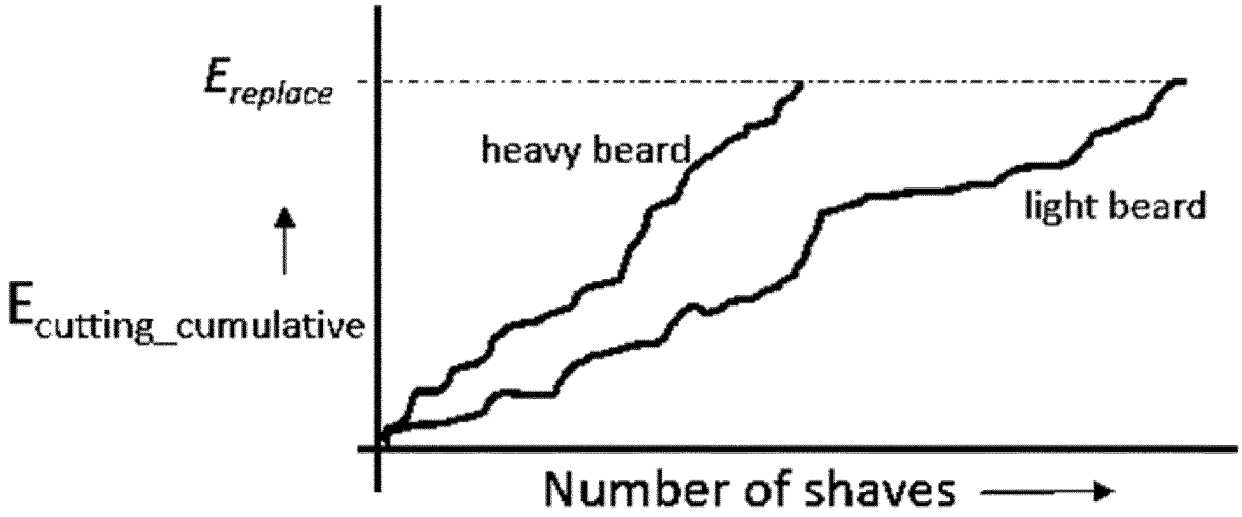
$E_{replace}$
heavy beard
light beard
$E_{cutting\_cumulative}$
Number of shaves

Figure 5

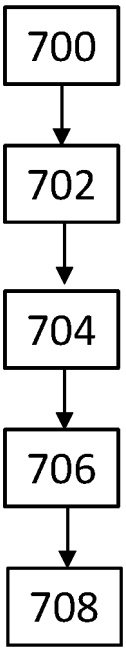

Figure 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 5045

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	US 2018/236674 A1 (VOORHORST FOKKE ROELOF [NL] ET AL) 23 August 2018 (2018-08-23) * paragraphs [0006] - [0014], [0022], [0037] - [0042], [0049] * * claims 1,2,5-7 * * figures 2,3,10 *	1-13	INV. B26B19/38
A	US 2023/034605 A1 (NEYER CHRISTIAN [DE] ET AL) 2 February 2023 (2023-02-02) * paragraphs [0011] - [0022], [0043] - [0062] * * figures 1-5 *	1-13	
A	US 2017/099199 A1 (BAUER MATTHEW STEPHEN [US] ET AL) 6 April 2017 (2017-04-06) * paragraphs [0001], [0002], [0017], [0019] - [0027], [0040] - [0050] * * figures 1,2,7-9 *	1-13	
A	US 2004/098862 A1 (ORLOFF GLENNIS J [US]) 27 May 2004 (2004-05-27) * paragraph [0068] * * claims 1,25,37 *	1-13	TECHNICAL FIELDS SEARCHED (IPC) B26B
A	US 2019/375121 A1 (PALERO JONATHAN ALAMBRA [NL] ET AL) 12 December 2019 (2019-12-12) * paragraph [0053] *	1-13	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	16 February 2024	Schouten, Adri

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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
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16-02-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018236674 A1	23-08-2018	BR 112017006886 A2	27-03-2018
		CN 106794583 A	31-05-2017
		EP 3204197 A1	16-08-2017
		JP 6509334 B2	08-05-2019
		JP 2017529967 A	12-10-2017
		RU 2017115682 A	13-11-2018
		US 2018236674 A1	23-08-2018
		WO 2016055509 A1	14-04-2016
US 2023034605 A1	02-02-2023	CN 115674284 A	03-02-2023
		EP 4124424 A1	01-02-2023
		JP 2023021077 A	09-02-2023
		US 2023034605 A1	02-02-2023
US 2017099199 A1	06-04-2017	CN 108136606 A	08-06-2018
		EP 3359354 A1	15-08-2018
		JP 6725651 B2	22-07-2020
		JP 2018532481 A	08-11-2018
		US 2017099199 A1	06-04-2017
		WO 2017062326 A1	13-04-2017
US 2004098862 A1	27-05-2004	AT E412497 T1	15-11-2008
		AT E552078 T1	15-04-2012
		AU 2003265546 A1	11-03-2004
		EP 1556191 A2	27-07-2005
		EP 2080597 A2	22-07-2009
		JP 2005536287 A	02-12-2005
		US 2004098862 A1	27-05-2004
		WO 2004018161 A2	04-03-2004
US 2019375121 A1	12-12-2019	BR 112019016933 A2	14-04-2020
		CN 110312598 A	08-10-2019
		EP 3363606 A1	22-08-2018
		EP 3582936 A1	25-12-2019
		JP 6649532 B1	19-02-2020
		JP 2020506771 A	05-03-2020
		PL 3582936 T3	31-05-2021
		RU 2019129722 A	22-03-2021
		US 2019375121 A1	12-12-2019
		WO 2018149738 A1	23-08-2018

EPO FORM P0459

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