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(54) **MOWER COMPONENTS**

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(52) **U.S. Cl.**

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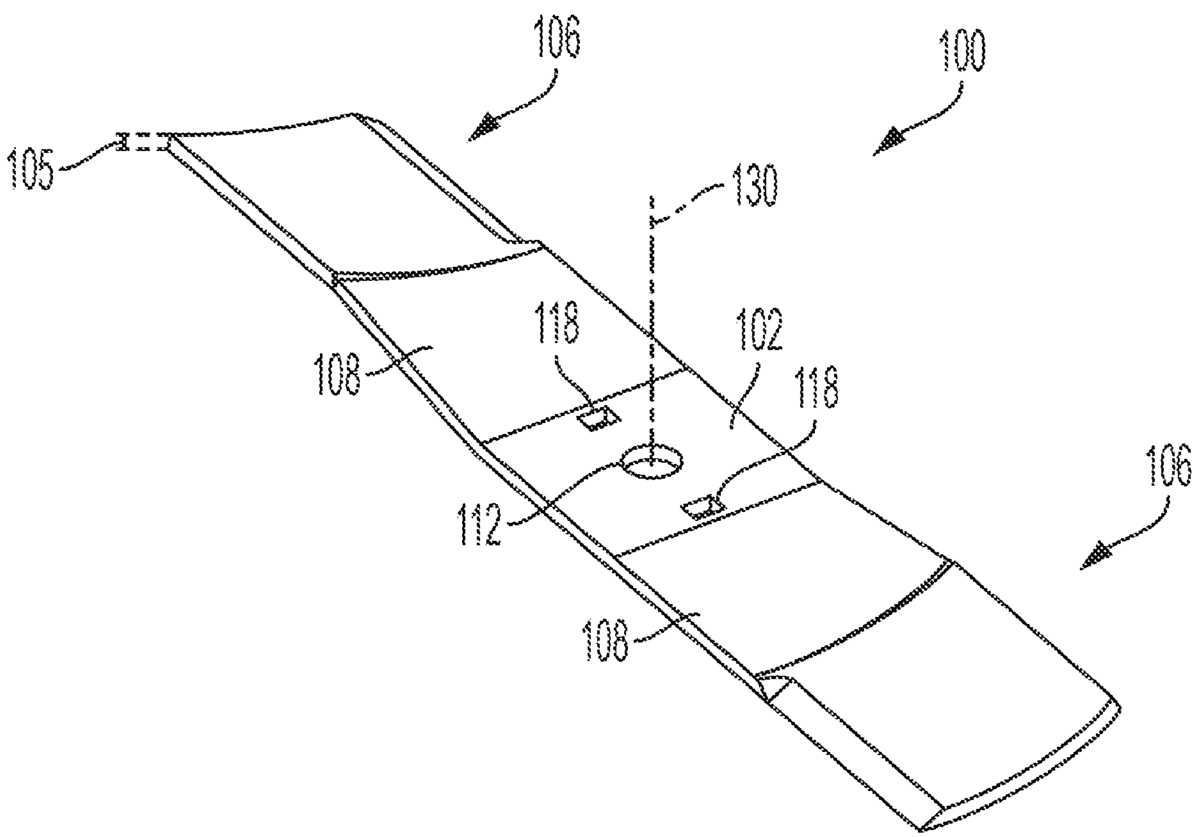
(57) **ABSTRACT**

Embodiments of blades for use with lawn mowers are provided herein. In some embodiments, a blade for a lawn mower includes a substantially flat central portion having a rotational axis configured to be coupled to a motor for rotating the blade; a distal portion extending radially from opposing sides of the flat central portion, the distal portion being a cutting region of the blade when mowing and defined by the following: a non-zero leading angle defining an angle of attack; and a non-zero camber percentage; and an intermediate portion disposed between the central portion and the distal portion and configured to minimize an amount of torsional stress between the central portion and the distal portion, wherein each distal portion comprises about 25 percent or less of a total length of the blade.



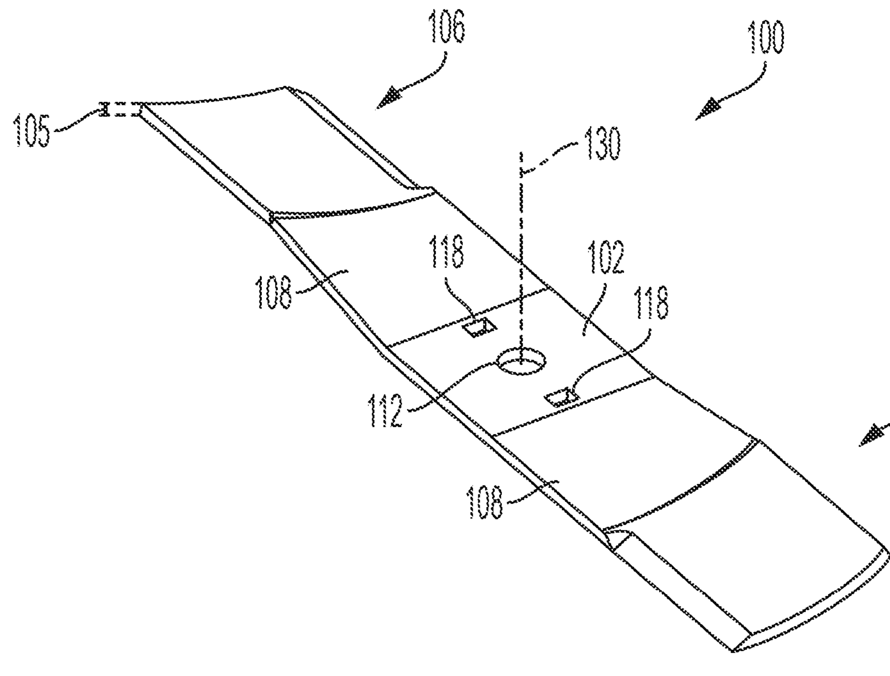

106
100
105
130
118
102
108
118
106
112
108

FIG. 1A

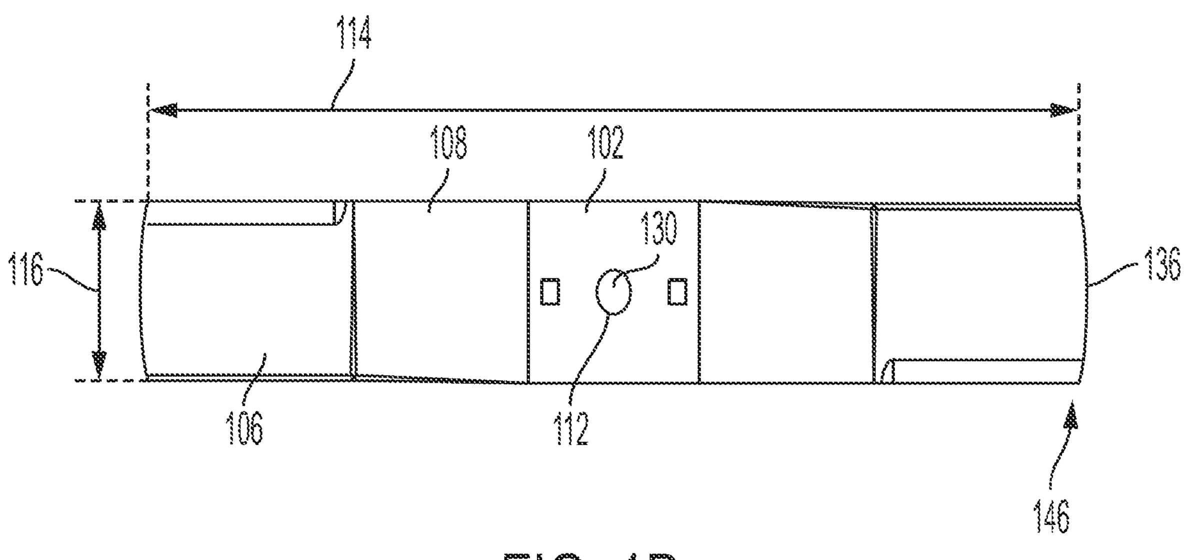

114
108
102
130
116
136
106
112
146

FIG. 1B

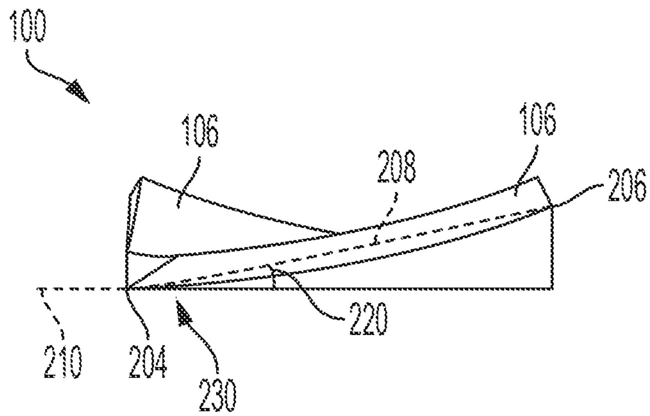

100
106
106
208
206
220
210
204
230

FIG. 2

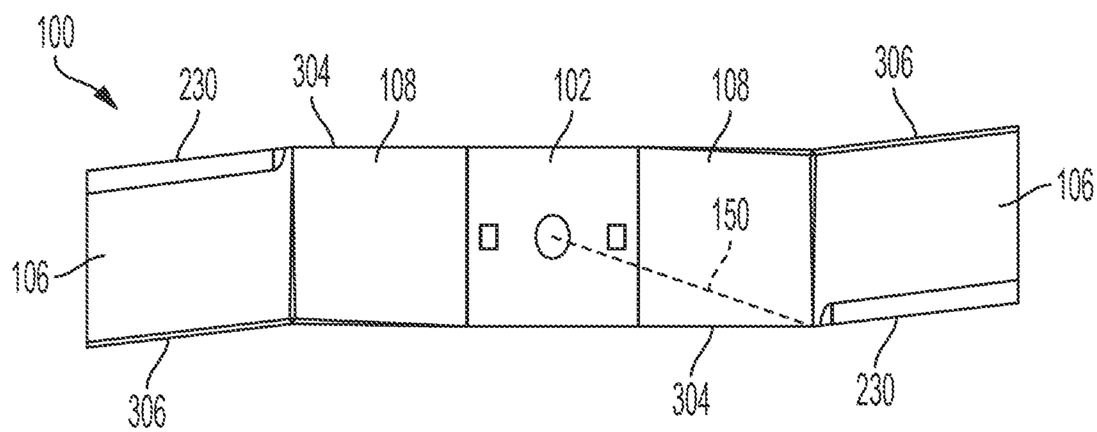

100
230
304
108
102
108
306
106
150
106
306
304
230

FIG. 3

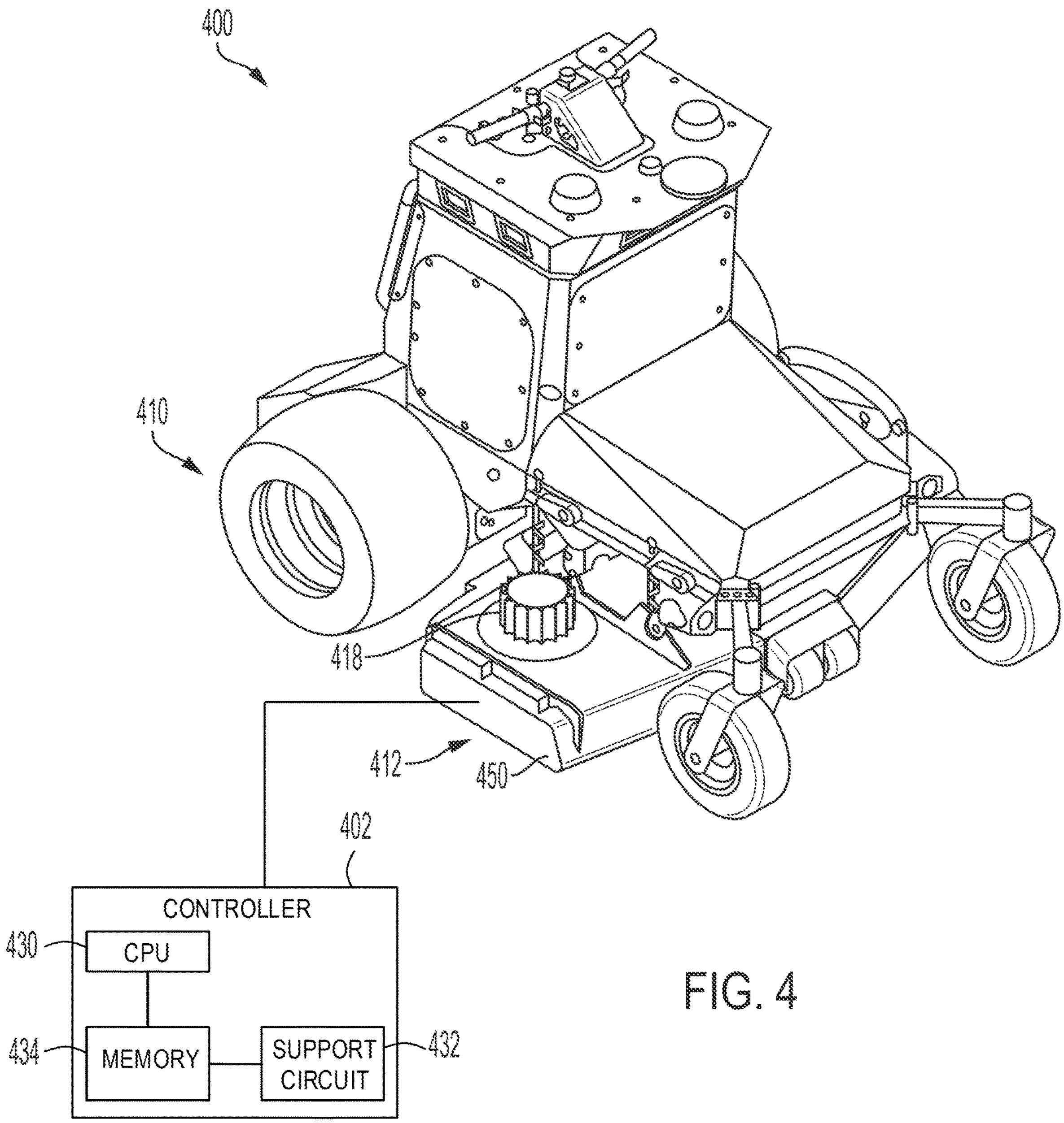

400
410
418
412
450
402
CONTROLLER
430
CPU
434
MEMORY
SUPPORT CIRCUIT
432

FIG. 4

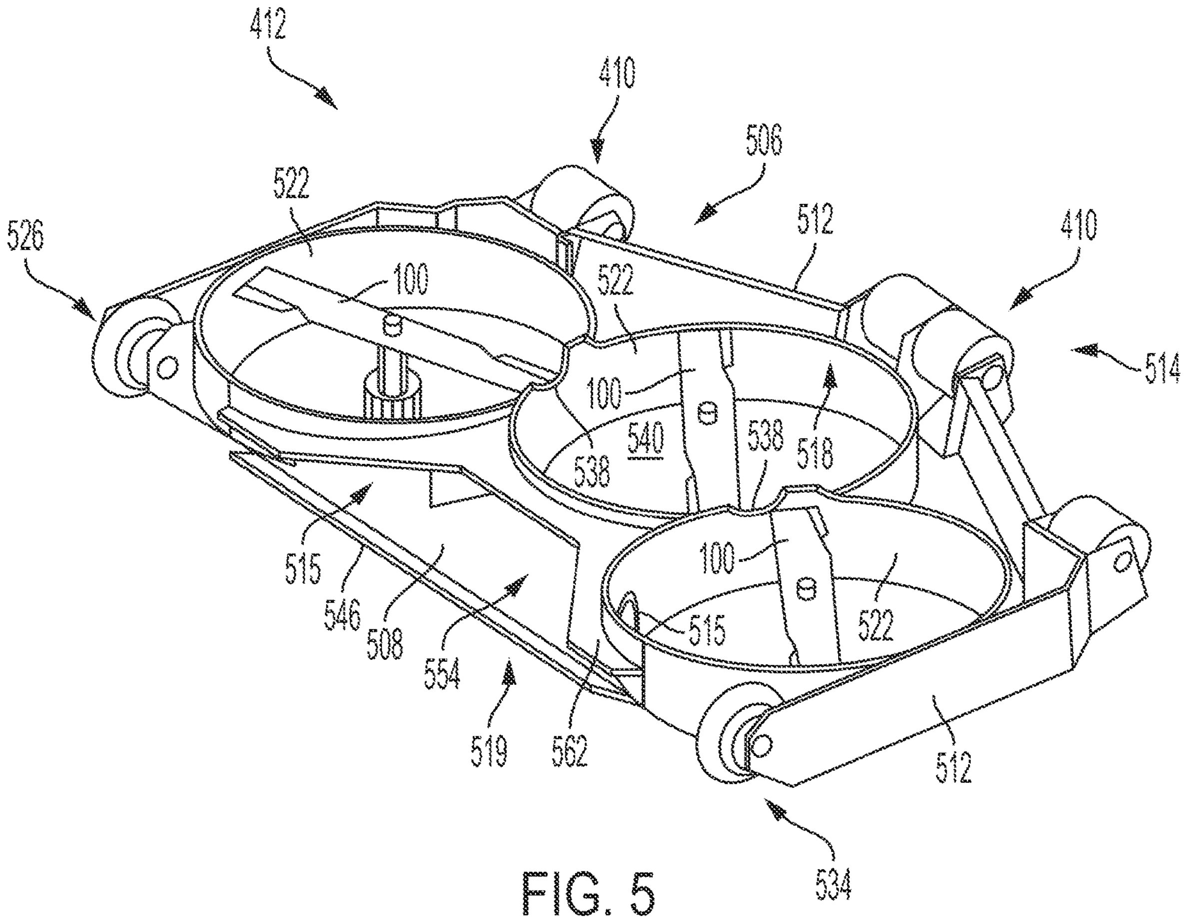

412
410
506
410
522
526
512
100
522
514
100
540
538
518
538
515
100
522
546
508
554
515
522
519
562
512
534

FIG. 5

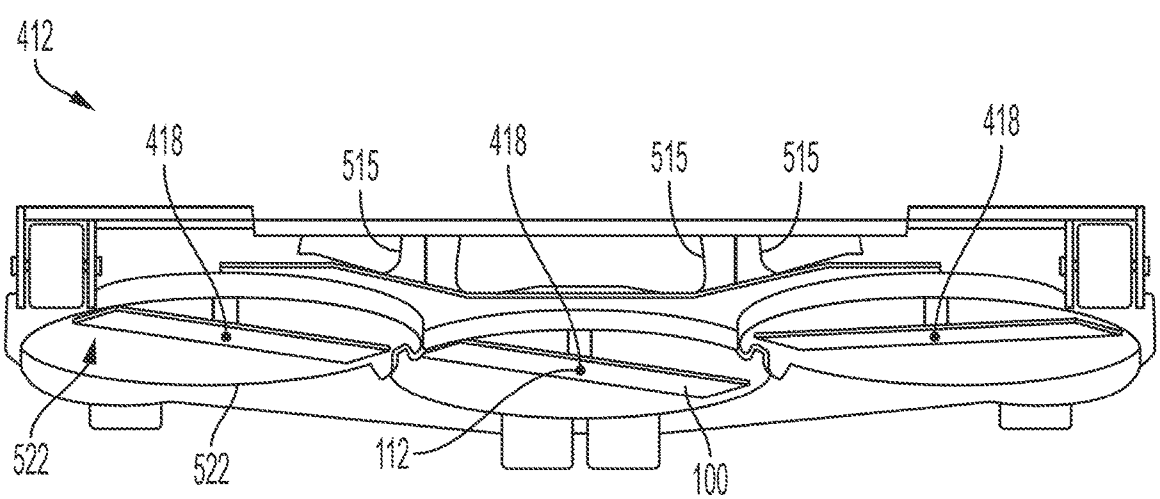

412
418
515
418
515
515
418
522
522
112
100

FIG. 6

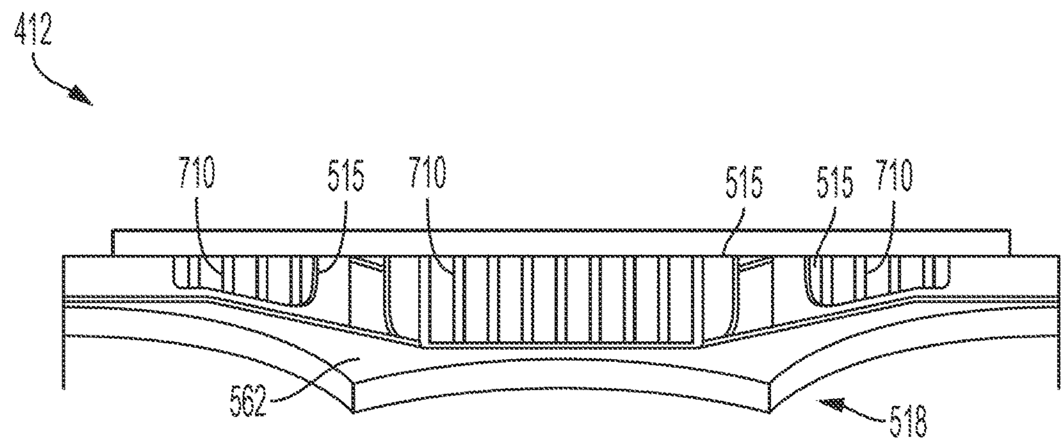

412
710
515
710
515
515
710
562
518

FIG. 7

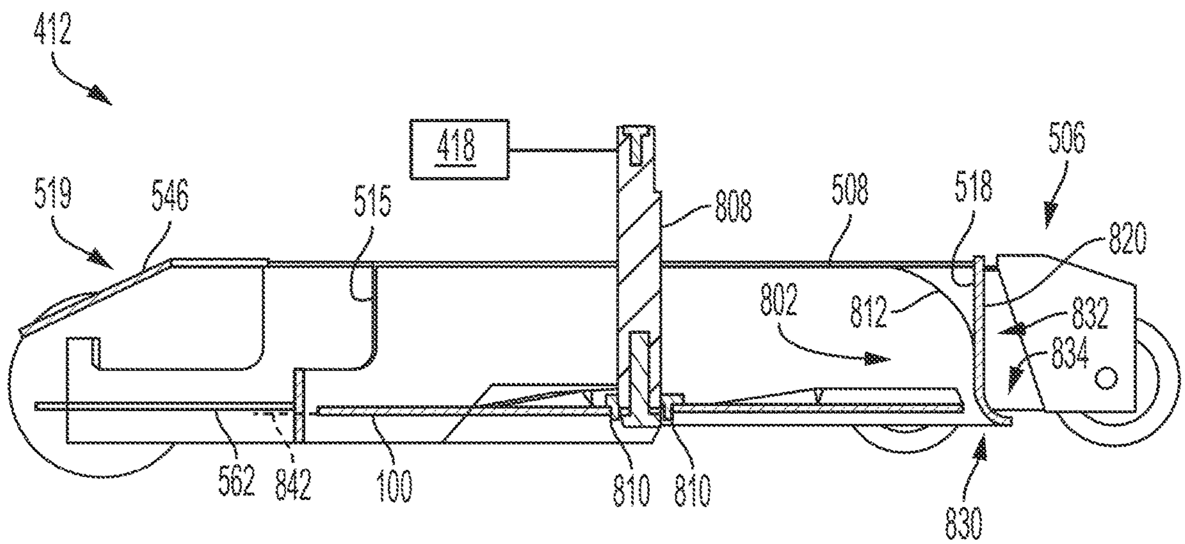

412
418
519
546
515
808
508
518
506
820
802
812
832
834
562
842
100
810
810
830

FIG. 8

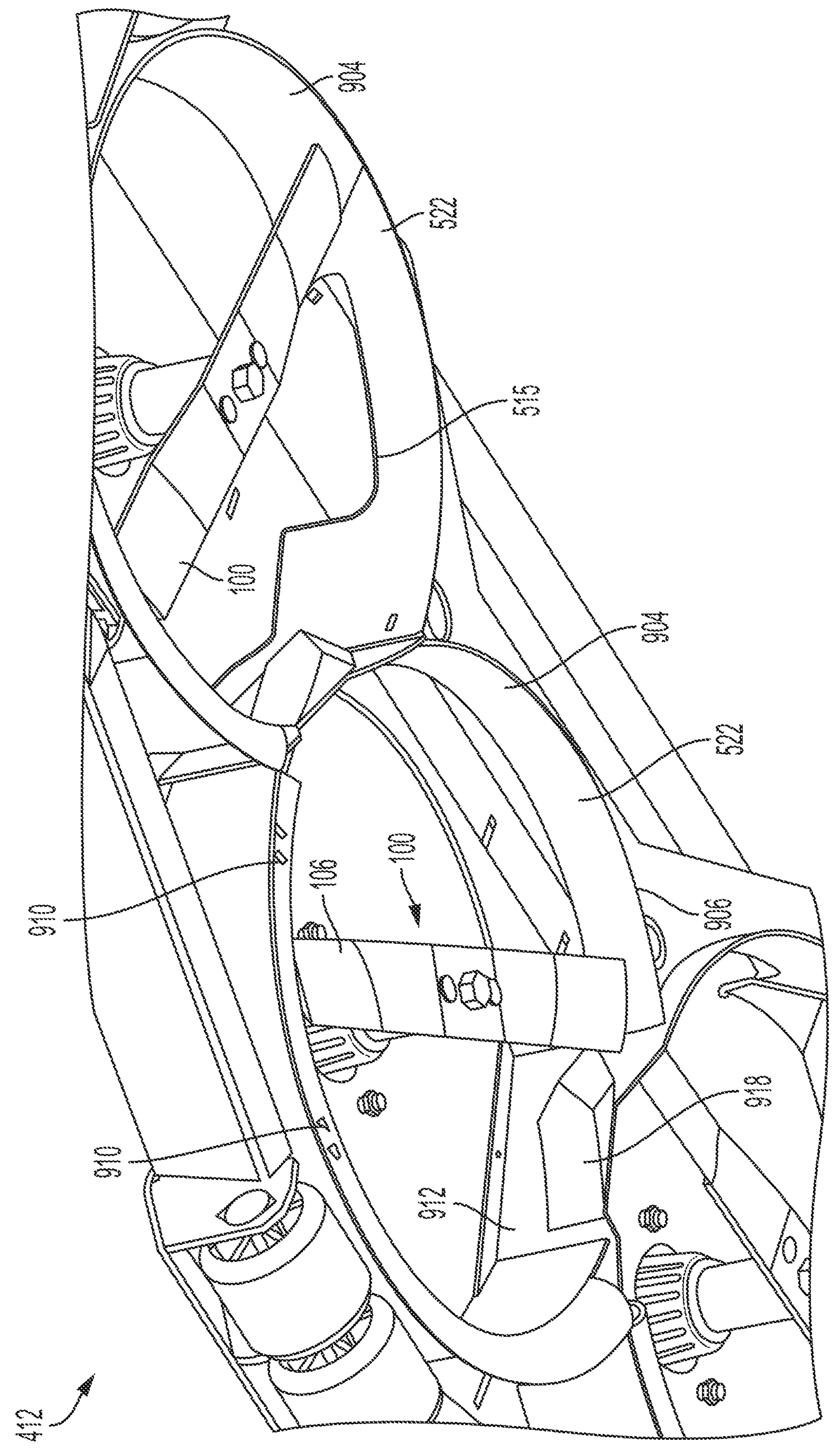


FIG. 9

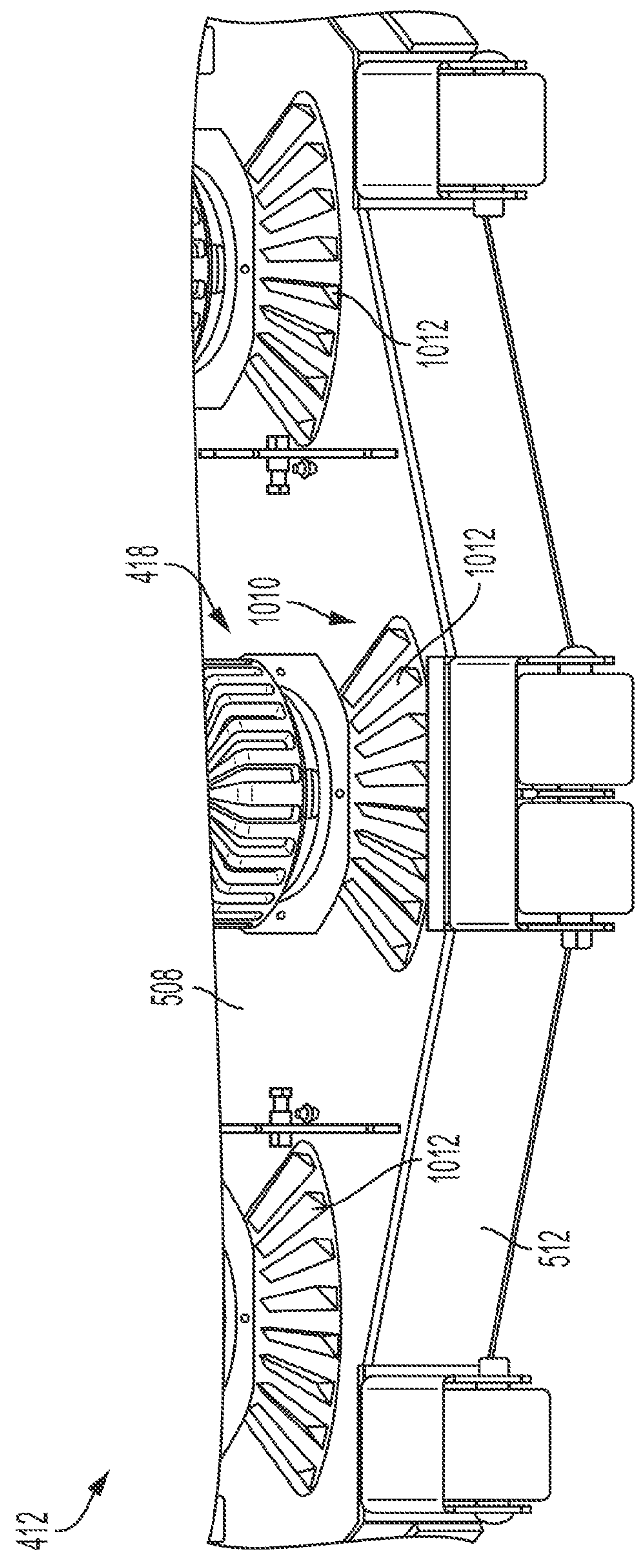


FIG. 10

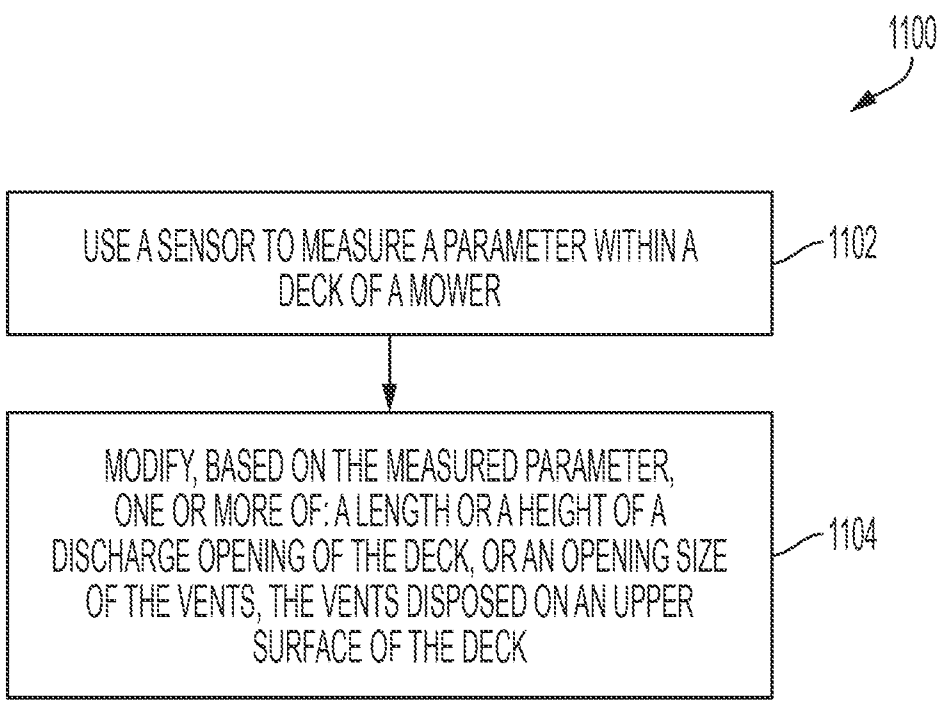

1100
USE A SENSOR TO MEASURE A PARAMETER WITHIN A DECK OF A MOWER
1102
MODIFY, BASED ON THE MEASURED PARAMETER, ONE OR MORE OF: A LENGTH OR A HEIGHT OF A DISCHARGE OPENING OF THE DECK, OR AN OPENING SIZE OF THE VENTS, THE VENTS DISPOSED ON AN UPPER SURFACE OF THE DECK
1104

FIG. 11

MOWER COMPONENTS

CLAIM OF PRIORITY

[0001] This application claims priority to U.S. Provisional Patent Application Ser. No. 63/245,498, filed Sep. 17, 2021, which is herein incorporated by reference in its entirety.

BACKGROUND

[0002] Mowers typically use rotary type blades for cutting. Various components utilize energy during mowing, such as when providing torque to motors that control motion of a mower, as well as those which turn the blades of the mower. Increased energy consumption can lead to shortened battery life or the need to increase a battery size, in the case of electric mowers, and/or shortened life or the need for larger fuel tanks in the case of mowers which rely on combustion engine technology.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Examples of the present disclosure, briefly summarized above and discussed in greater detail below, can be understood by reference to the illustrative examples of the disclosure depicted in the appended drawings. However, the appended drawings illustrate only typical examples of the disclosure and are therefore not to be considered limiting of scope, for the disclosure may admit to other equally effective examples.

[0004] FIG. **1**A depicts an isometric view of a blade for a lawn mower in accordance with at least some examples of the present disclosure.

[0005] FIG. **1**B depicts a top view of a blade for a lawn mower in accordance with at least some examples of the present disclosure.

[0006] FIG. **2** depicts a side view of a blade for a lawn mower in accordance with at least some examples of the present disclosure.

[0007] FIG. **3** depicts a top view of a blade for a lawn mower in accordance with at least some examples of the present disclosure.

[0008] FIG. **4** depicts an isometric view of a mower in accordance with at least some examples of the present disclosure.

[0009] FIG. **5** depicts bottom isometric view of a deck assembly in accordance with at least some examples of the present disclosure.

[0010] FIG. **6** depicts a schematic bottom isometric view of a deck assembly in accordance with at least some examples of the present disclosure.

[0011] FIG. **7** depicts a bottom isometric view of a portion of a deck assembly in accordance with at least some examples of the present disclosure.

[0012] FIG. **8** depicts a schematic cross-sectional side view of a deck assembly in accordance with at least some examples of the present disclosure.

[0013] FIG. **9** depicts bottom isometric view of a deck assembly in accordance with at least some examples of the present disclosure.

[0014] FIG. **10** depicts a top isometric view of a deck assembly in accordance with at least some examples of the present disclosure.

[0015] FIG. **11** depicts a flow chart of a method for adjusting one or more of baffles or vents of a mower in accordance with at least some examples of the present disclosure.

[0016] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. The figures are not drawn to scale and may be simplified for clarity. Elements and features of one example may be beneficially incorporated in other examples without further recitation.

DETAILED DESCRIPTION

[0017] Various techniques (methods, systems, apparatus, etc.) are described herein which may improve the effective operating time (e.g., battery life, efficiency, etc.) of a mower (whether electric, combustion engine, or some combination thereof) by providing an enhanced design for multiple components of a lawn mower, including, but not limited to blades, decks, etc. Further, the techniques described in detail herein may improve an overall cut quality of lawn when using the components described. As non-limiting examples of such, the components described herein may promote even cuts (e.g., by ensuring grass blades are standing up), increase the amount of mulching of grass prior to discharge, as well as ensure any discharge is in optimal locations. In some examples described herein, a lawn mower blade may have an airfoil region having a non-zero camber configured to reduce flow separation to improves blade efficiency. For example, such a design creates a smoother transition from a lower pressure side of the blade to the free stream flow, minimizing vortex production and shedding. In at least some examples, the blade may operate in a non-stall condition as opposed to a stalled condition. In a non-stall condition, the blade generally facilitates laminar or near-laminar flow over the blade. In a stalled condition, the blade generates large amounts of lift but also generates an exceptional amount of drag, causing flow separation and turbulent flow to occur almost immediately on the low pressure side of the blade, resulting in a decrease in blade efficiency. By utilizing the techniques described herein, a non-stall condition may be achieved to reduce the amount of drag (and, therefore, increase the efficiency) of operating such blades.

[0018] The blade may be installed in a deck of the mower. As will be described in detail herein, the geometry of the blade may allow for a greater increase in air speed around a bottom of blade, which in turn reduces the pressure under the blade. Such a pressure reduction under the blade may increase the mass flow into the deck, creating more suction and facilitating glass blades to stand up to be cut, improving mower cutting efficiency. The blade may be combined with a deck having a baffle having a discharge, such as a rear discharge, for providing better fertilization, safer operation, and increasing mower efficiency. The baffle and discharge advantageously may ensure that projectiles are maintained, and clipping are not spread over safety critical surfaces such as roadways, or the like. The baffle, combined with the blade, may promote the flow of clippings up and to the discharge of the mower. As will be described in detail herein, the baffle may be adjusted during operation to provide optimal efficiency in various situations, as well as allow for user control of mulching, etc. Further, such baffling and ducts may comprise various features to promote desired mass flow, mulching, etc. including, but not limited to, louvers, various shapes, Coanda inserts, and the like.

[0019] FIG. **1**A depicts an isometric view of a blade **100** for a mower in accordance with at least some examples of the present disclosure. FIG. **1**B depicts a top view of a blade **100** for a mower in accordance with at least some examples of the present disclosure. In some examples, the blade **100** is a flat plate of material (such as high carbon steel, aluminum, or any other material able to withstand high amounts of torque while retaining shape) that is bent to create a non-zero camber. The blade **100** generally comprises a substantially flat central portion **102** having a rotational axis **130** configured to be coupled to a motor (see motor **418** in FIG. **4**) for rotating the blade **100**. In some examples, the central portion **102** has an opening **112** configured for coupling the blade **100** to the motor **418**. In some examples, the flat central portion **102** includes one or more peripheral openings **118** disposed radially outward of the opening **112** for receiving one or more respective fasteners (see fasteners **810** in FIG. **8**) to couple the blade **100** to a shaft of the motor **418**.

[0020] In at least some examples, such as the examples shown in FIG. **1**A, the blade **100** may include a distal portion **106** defined as an airfoil portion extending radially outward from opposing sides of the flat central portion **102**. The distal portion **106** may be a region of the blade **100** predominantly used for cutting when mowing. Such an airfoil design may be any design capable of generating some amount of lift. In at least some such examples, the amount of lift may be determined to ensure that the blade is operating in a non-stall configuration during mowing (e.g., when spinning at up to 5000 rpm or higher).

[0021] In some examples, the distal portion **106** may be defined by a non-zero leading angle **220** defining an angle of attack. FIG. **2**A depicts a side view of a blade **100** for a mower in accordance with at least some examples of the present disclosure. In some examples, the non-zero leading angle **220** of the distal portion **106** may be measured as an angle relative to a horizontal axis **210** originating from a bottom leading edge point **204** of the blade **100** and a line **208** projected between the bottom leading edge point **204** and a bottom trailing edge point **206**. In some examples, the non-zero leading angle **220** may vary across one or more of the width and/or length of the blade **100**.

[0022] In some examples, the non-zero leading angle **220** may be substantially constant across the distal portion **106**. However, in other examples, such a non-zero leading angle **220** may vary over the radius of the blade (e.g., extending in a direction from the rotational axis **130**) in any manner (e.g., linearly, exponentially, or otherwise). In some examples, the non-zero leading angle **220** at the distal portion **106** is about 15 degrees to about 45 degrees, although any other range is contemplated. In some examples, the non-zero leading angle **220** is about 25 to about 35 degrees.

[0023] The non-zero leading angle **220** being too low may lead to less efficient mass flow generation. The non-zero leading angle **220** being too high may lead to flow separation, resulting in uneven cutting. In some examples, the distal portion **106** curves upward from respective ones of the bottom leading edge point **204** on either side of the blade **100**. In some examples, the distal portion **106** may curve upward about 0.4 to about 0.7 inches from the bottom leading edge point **204**.

[0024] In some examples, the distal portion **106** may be further defined by a non-zero camber percentage. In various examples, an amount of camber is determined as a percentage of a chord width **116**. As a non-limiting example, the non-zero camber percentage may be approximately 2 to 12 percent, however any other range is contemplated. In some examples, the amount of camber may vary along the length of the blade **100**, e.g., linearly, non-linearly, or some combination thereof. In some examples, the non-zero camber percentage varies along the chord width **116** of the blade **100** such that at least a portion of a leading edge **230**, for example, the leading edge **230** corresponding with the bottom leading edge point **204** of the distal portion **106**, is substantially flat. In some examples, the leading edge **230** of the distal portion **106** is sharpened, as illustrated by the tapering of the blade to the bottom leading edge point **204**.

[0025] In various examples, the distal portion **106** is dimensioned to be large enough to provide sufficient cutting revolutions and small enough as to avoid excessive strain on the material of the blade **100** which can lead to stress fracture. In some examples, a distal portion **106** comprises an outer (or distal) portion of the blade having a length of about 15% to about 30% of the radius of the blade **100** (e.g., the distance from the center to the distal end), though any percentage (from 0 to 100%) is contemplated. In some examples, a distal portion **106** comprises about 25 percent or less of a total length of the blade. In some examples, the cambered region may be located at other locations along a length **114** of the blade **100** from the opening **112** to a distal end **146**.

[0026] In some examples, an intermediate portion **108** may be disposed between the flat central portion **102** and a distal portion **106**. In such examples, the intermediate portion may be configured to minimize an amount of torsional stress between the central portion **120** and the distal portion **106**. In some examples, the intermediate portion **108** is flatter on a side proximate the flat central portion **102** than a side proximate the distal portion **106**.

[0027] In any example discussed herein, the blade **100** may further be defined by a thickness **105**, and the thickness **105** may be based in part on the chord width **116**. As a non-limiting example of such, the thickness **105** may be determined as a percentage, e.g., 10%, 15%, 5%, etc., of the chord width **116**. In some examples, the chord width **116**, or width of the blade **100**, is about two to about three inches. In some examples, a thickness of the blade **100** is about 0.15 inches to about 0.2 inches. In some examples, a chord width **116** of the blade **100** is substantially the same across a length of the blade **100**. Of course, it is contemplated that a thickness of the blade may vary across a length and/or width of the blade to achieve an ideal moment of inertia, increase an efficiency of spinning the blade, or otherwise achieve an optimal cut.

[0028] In some examples, the distal portion **106** may be curved about an edge **136** furthest from the rotational axis **130** based at least in part on a curve associated with a baffle surrounding the blade **100** when attached to the motor (discussed in more detail below). Such a curve of the blade **100** may be designed such that a minimal space is left between the distal portion of the blade and a wall of the housing or surrounding baffle when the blade is attached to the motor and spinning. In such examples, the edge **136** being curved advantageously improves suction underneath the blade **100** by reducing an amount of air from a high-pressure region that can leak over the edge **136** when the blade **100** is installed and in use.

[0029] FIG. **3** depicts a top view of a blade **100** for a mower in accordance with at least some examples of the present disclosure. In some examples, the leading edge **230** at the distal portion **106** may be swept backwards either linearly with respect to a radius **150** of the blade **100** as depicted in FIG. **3**, or in a curve along the radius **150** such that the blade **100** creates more of a "slicing" instead of "hacking" motion on grass blades as the blade **100** rotates. In some examples, the leading edge **230** is swept backwards with respect to a leading edge **304** of the intermediate portion **108**. A swept back geometry may increase the effective surface length of the blade **100** on a per-revolution basis. In some examples, the trailing edge **306** of the distal portion **106** is swept backwards similarly and in the same direction as the corresponding leading edge **230**. In some examples, one or more of the leading edge **230** or the trailing edge **306** are tapered. An amount the distal portion **106** is swept back may be defined by a distance or an angle. In various examples, such a distance or angle may be determined based at least in part on one or more of a length of the blade **100**, a length and/or width of the distal portion, or otherwise. As a non-limiting example of such, the distal portion **106** may be swept back by an angle of 1 degree, 2 degrees, 5 degrees, etc. relative to a line extending radially from the center of the blade **100**. Each of the various elements of the blade design described herein may be incorporated separately. In other examples, multiple elements of blade design described herein may be incorporated together.

[0030] FIG. **4** depicts an isometric view of a mower **400** in accordance with at least some examples of the present disclosure. The mower **400** may generally include a plurality of wheels **410** configured to move the mower **400**. A deck assembly **412** may be disposed between the plurality of wheels **410** and includes one or more blades **100** disposed therein and coupled thereto. The deck assembly **412** includes one or more motors **418** corresponding with the one or more blades **100**. The mower **400** may be any suitable mower, for example, a lawn mower, a push mower, a riding mower, an autonomous mower, and the like. One particular example is an autonomous lawn mower of the type depicted in FIG. **4**. In some examples, the mower **400** includes a sensor **450** configured to measure a parameter in the deck assembly **412**. For example, the parameter may be strain of motor, torque, pressure, temperature, or the like. In other examples, the sensor **450** may comprise a perception system having at least one of an auditory system or visual system. For example, the auditory system may include a microphone. The visual system may include a camera to receive visual input.

[0031] Examples in accordance with the present disclosure may be implemented in hardware, firmware, software, or any combination thereof. Examples may also be implemented as instructions stored using one or more computer readable media, which may be read and executed by one or more processors. A computer readable medium may include any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computing platform or a "virtual machine" running on one or more computing platforms). For example, a computer readable medium may include any suitable form of volatile or non-volatile memory. In some embodiments, the computer readable media may include a non-transitory computer readable medium. For example, a controller **402** controls the operation of the mower **400** and may be used to perform the methods described herein. In some examples, the controller **402** takes input from the sensor **450**. In some examples, the controller **402** may be used to control the discharge openings **515** discussed in more detail below.

[0032] The controller **402** generally includes a central processing unit (CPU) **430**, a memory **434**, and a support circuit **432**. The CPU **430** may be one of any form of a general-purpose computer processor that can be used in an industrial setting. The support circuit **432** is conventionally coupled to the CPU **430** and may comprise a cache, clock circuits, input/output subsystems, power supplies, and the like. Software routines, such as processing methods as described herein may be stored in the memory **434** and, when executed by the CPU **430**, transform the CPU **430** into the controller **402**. The software routines may also be stored and/or executed by a second controller (not shown) that is located remotely from the mower **400** (e.g., a mobile device, computer, etc.).

[0033] In operation, the controller **402** enables data collection and feedback from the mower **400**, for example, from the sensor **450**, to optimize performance of the mower **400** and provides instructions to system components. For example, the memory **434** can be a non-transitory computer readable storage medium having instructions that when executed by the CPU **430** (or controller **402**) perform the methods described herein.

[0034] FIG. **5** depicts bottom isometric view of a deck assembly **412** in accordance with at least some examples of the present disclosure. FIG. **6** depicts a schematic bottom isometric view of a deck assembly **412** in accordance with at least some examples of the present disclosure. The deck assembly **412** includes an intake side **514** and a discharge side **534**. In some examples, the deck assembly **412** includes a deck housing **506** having an upper plate **508** and sidewalls **512** extending down from the upper plate **508** to define an interior volume **520** of the deck housing **506**. The deck housing **506** generally includes a baffle body **518** coupled to the deck housing **506** within the interior volume **540**. The baffle body **518** is disposed about the blade **100** for controlling air flow within the deck assembly **412** and promoting discharge of cut material in a particular direction. The baffle body **518** defines one or more cutting chambers **522**, which in some examples may have a substantially circular structure with a diameter approximately equal to a diameter of the blade **100** to be used with the mower and at least partially encircling the blade **100**. In some examples, a diameter of the one or more cutting chambers **522** of the baffle body **518** is less than or equal to approximately one half of an inch larger than a diameter of the blade **100**, though any other distance is contemplated.

[0035] In some examples, the one or more cutting chambers **522** comprises three cutting chambers, as depicted in FIG. **5**. Separate cutting chambers substantially prevent vortex interactions between adjacent blades **100**. In some examples, the baffle body **518** includes a recess **538** disposed between adjacent ones of the one or more cutting chambers **522** to direct airflow therebetween. In some examples, the one or more cutting chambers **552** are arranged in a staggered position such that the rotational axis of the respective blades **100** disposed in the one or more cutting chambers **552** are not disposed along a common line. Such a staggering may, in some cases, ensure optimal aesthetic cuts. In some examples, one of the cutting chambers is disposed closer to the intake side **514** and two of the cutting chambers are disposed closer to the discharge side **534**. In some examples, a gap between the blade **100** and the respective one of the one or more cutting chambers **522** is about 0.03 to about 0.25 inches, though any distance is contemplated. A small gap may improve efficiency of mass flow creation by reducing the vortex shedding that is generated when lift from the blade **100** is produced.

[0036] In some examples, the baffle body **518** may include one or more discharge openings **515** proximate the discharge side **534**. For example, the baffle body **518** may include a discharge opening **515** for each of the one or more cutting chambers **522**. In some examples, the one or more discharge openings **515** are disposed in an upper portion **526** of the baffle body **518**. A size of the one or more discharge openings **515** can be adjusted to tune the amount of mulching-action performed by the deck assembly **412** (e.g., coarser or finer), and may be user-adjustable. The discharge openings **515** may be comprised of slats having an adjustable width and or height. The slats may ensure that clumps are not ejected, while the baffles overall may ensure that pressure above the blade is controlled. The size may be adjusted, for example, via sliding or rotating components that increase or decrease the size of the one or more discharge openings **515**. Such modifications may further alter operation of the mower to discharge more clippings to the rear (creating a rear-discharge mower) and/or otherwise promoting airflow to keep clippings circulating internal to the chamber for longer periods of time to create a finer cut.

[0037] In some examples, such an adjustment may be performed by one or more processors associated with the mower **400** (such as for those mowers that are fully and/or partially autonomously controlled). For example, such an adjustment may be performed via the controller **402**. In various examples, such discharge openings **515** may be louvers actuated by one or more motors. Such motors, in turn, may be controlled in accordance with a user interface (e.g., either on the mower itself or remote therefrom (e.g., a mobile device, computer, etc.), or otherwise adjusted during autonomous operation of the mower based on, for example, recognition of a type of grass to be mowed (e.g., as may be determined based on, for example, camera data on board the mower and available to the processor(s)), a user pre-defined preference, geographic area, or the like. In at least some examples, a pressure sensor located proximate the cavity housing the blades may be used for controlling opening or closing of the baffles (e.g., sensor **450**). As a non-limiting example of which, an increase in pressure may trigger increasing one or more of a height or width of a baffle to reduce an amount of strain on the motor, decrease an amount of torque required to spin the blade at a desired speed, or the like.

[0038] A rear-upper portion **519** of the deck assembly **412** may include an exhaust opening **554** to allow for the exhaust of the airflow and particulate (e.g., clippings) that pass through the one or more discharge openings **515** of the deck assembly **412**. A size of the exhaust opening **554** can be adjusted to tune the amount of mulching-action performed by the deck assembly **412** (e.g., coarser or finer), and may be user-adjustable. In some examples, such an adjustment may be performed by a processor associated with the mower **400** (such as for those mowers that are fully and/or partially autonomously controlled). Such controls may be similar or the same as those discussed in detail above. The size of the exhaust opening **554** may also control a pressure above the blades **100**. In some examples, the baffle body **518** includes a rear lip **562** coupled to the one or more cutting chambers **522** that, together with the upper plate **508**, partially defines the exhaust opening **554**. In some examples, the rear lip **562** is raised with respect to a lower surface of the one or more cutting chambers **522**.

[0039] In some examples, the baffle body **518** includes a discharge gate **546** that may be moved to adjust the size of the exhaust opening **554**. The discharge gate **546** may be configured to facilitate ejecting smaller clippings and redirect larger clippings back into the one or more cutting chambers **522**. For example, the discharge gate **546** may rotate with respect to the upper plate **508** to change the size of the exhaust opening **554**. In another example, the discharge gate **546** may comprise a plurality of gates that slide laterally or rotate to adjust a width and height of the exhaust opening **554** or the discharge opening **515**. In some examples, a portion of the baffle body **518** is adjustable to modify one or more of a length or a height of the discharge opening **515** or the exhaust opening **554**.

[0040] The one or more discharge openings **515** and the exhaust opening **554** allow for mass and particulate flow out of the deck assembly **412** while still allowing for vortex management. The vortex management prevents vortices from being cast toward a suction side of the blade **100** which would then prevent mass flow underneath and into the one or more cutting chambers **522**.

[0041] FIG. **7** depicts a bottom isometric view of a portion of a deck assembly **412** in accordance with at least some examples of the present disclosure. In some examples, the baffle body **518** further comprises a structure **710** configured to eject small clippings and redirect larger clippings back into the one or more cutting chambers **522**. In some examples, the structure **710** comprises slats disposed in the one or more discharge openings **515**.

[0042] The slats may have a conventional or aerodynamic shape that limit the size of ejected clumps of particulate. The slats may prevent large clumps (undesirable) from easily ejecting over the top, either forcing them to separate into smaller and less unsightly (or more easily compostable) pieces as the airflow pushes them through, or by causing tangential and/or rotating flows to pull the clump away from the exhaust opening **554** where they will be churned and have increased likelihood of being chopped into smaller pieces by the blade **100** again. In at least some such examples, the slats may provide an added structural-integrity benefit as well to the baffle body **518**

[0043] FIG. **8** depicts a schematic cross-sectional side view of a deck assembly **412** in accordance with at least some examples of the present disclosure. In some examples, one or more fasteners **810** may coupled the blade **100** to a shaft **808** of the motor **418**. In some examples, a forward-facing portion **802** of the baffle body **518** comprises one or more of: a curved structure **812** along a portion of the baffle body **518** coupled to the deck housing **506**. In at least some examples, the curved structure **812** may comprise a Coanda insert.

[0044] The curved structure **812** may generally be a rounded insert disposed proximate an upper end of a sidewall **820** of the baffle body **518**. The curved structure **812** advantageously eliminates a corner which may lead to stagnant or turbulent flow, reducing mower efficiency. The curved structure reduces or removes low pressure above the blade **100**. The curved structure **812** may be a modular plastic, metal, or composite insert that can be linked with other inserts and the deck assembly **412** to form a ring around one or more cutting chambers **222** of the deck assembly **412**.

[0045] The curved structure **812**, in some examples, may help vertical airflow stay attached to the baffle body **518** and ensures that mass-flow is moving as vertical as possible near the blade **100** instead of having a large lateral velocity component, all of which improving efficiency and/or promoting rear discharge, discharge of a particular coarseness, safety (e.g., preventing high velocity of larger potential projectiles), prevent damage to multiple blade systems proximate one another, etc. In at least some examples, the curved structure **812** may allow for vortices created inside the deck to be redirected in the direction determined (e.g., by a user, machine, processor, controller, etc.).

[0046] In some examples, the forward-facing portion **802** of the baffle body **518** comprises a diffuser **830** to promote laminar airflow in a vertical direction. In some examples, the diffuser **830** comprises one or more of a bell mouth. In some examples, the diffuser **830** includes an upper vertical portion **832** and a lower curved portion **834** extending downward and radially outward of the upper vertical portion **832**. In some examples, a cutting plane **842** of the blade **100** is disposed vertically below the discharge opening **515**.

[0047] FIG. **9** depicts bottom isometric view of a deck assembly **412** in accordance with at least some examples of the present disclosure. In some examples, the diffuser **830** includes vortex generators **910**. The vortex generators **910** comprise small structures, for example, in the form of triangles or angled pieces, that promote flow attachment to the diffuser **830** by mixing or spinning air in a local region proximate the vortex generators **910**. The vortex generators **910** may be integrated into the baffle body **518** or be coupled to the baffle body **518**. In some examples, the vortex generators **910** are disposed on the lower curved portion **834** of the diffuser **830**. The vortex generators **910** may also reduce lateral velocity of the mass flow which may be forcing grass to lay down instead of standing up.

[0048] In some examples, an inner surface **912** of the cutting chamber **522** includes an angled surface **918** disposed proximate a lower end **906** of a sidewall **904** of the cutting chamber **522**. In some examples, the angled surface **918** is disposed above the cutting plane **842** of the blade **100**. The angled surface **918** is configured to recirculate large clipping to control particulate size.

[0049] FIG. **10** depicts a top isometric view of a deck assembly **412** in accordance with at least some examples of the present disclosure. In some examples, the deck assembly **412** includes a vent **1010** disposed on the deck housing **506** above the cutting chamber **522** to relive pressure build up above the blade **100**. In some examples, the vent **1010** is disposed through the upper plate **508**. In some examples, the vent **1010** comprises an adjustable louver disposed above each of the one or more cutting chamber **522** facing in a direction opposite a blade spin direction. For example, the vent **1010** may comprise a plurality of horizontal slats with an angled covering **1012**. The size of the openings of the vent **1010** may be adjustable, for example, by selectively covering portions of the plurality of horizontal slats or otherwise actuating a mechanism for modulating the size. The direction opposite the blade spin direction advantageously allows for air to flow through the louver while preventing clippings (which are heavier than air) from exiting through the louver. In some examples, the vent **1010** is arranged proximate the intake side **514** to provide vertical airflow.

[0050] FIG. **11** depicts a flow chart of a method **1100** for adjusting one or more of baffles (i.e. baffle body **518**) or vents (i.e., vents **1010**) of a mower (i.e., mower **400**) in accordance with at least some examples of the present disclosure. At **1102**, the method **1100** includes using a sensor (i.e. sensor **450**) to measure a parameter within a deck (i.e. deck assembly **412**) of the mower. In some examples, the parameter is a pressure, a temperature, torque of a motor (i.e., motor **418**) of the mower, or a strain of the motor.

[0051] At **1104**, the method **1100** includes modifying, based on the measured parameter, one or more of: a length or a height of a discharge opening (i.e., discharge opening **515**) of the deck, or an opening size of the vents, the vents disposed on an upper surface of the deck. In some examples, the vent comprises an adjustable louver facing in a direction opposite a blade spin direction.

[0052] In some examples, the method **1100** includes increasing the length or the height of the discharge opening when the pressure, the temperature, the torque on the motor, or a strain of the motor is greater than a threshold pressure, threshold temperature, threshold torque on the motor, or threshold strain on the motor. In some examples, the discharge opening is disposed about 0.5 inches or more above a cutting plane (i.e., cutting plane **842**) of the mower. The discharge opening may be adjusted via sliding or rotating components or surfaces that selectively cover portions of the discharge opening.

[0053] In some examples, the method **1100** includes increasing the opening size of the vents when the pressure, the temperature, the torque on the motor, or a strain of the motor is greater than a threshold pressure, threshold temperature, threshold torque on the motor, or threshold strain on the motor.

[0054] While the foregoing is directed to examples of the present disclosure, other and further examples of the disclosure may be devised without departing from the basic scope thereof.

1. A blade for a mower, comprising:

a substantially flat central portion having a rotational axis configured to be coupled to a motor for rotating the blade;

a distal portion extending radially from opposing sides of the flat central portion, the distal portion being a cutting region of the blade when mowing and defined by the following:

a non-zero leading angle defining an angle of attack; and

a non-zero camber percentage; and

an intermediate portion disposed between the central portion and the distal portion and configured to minimize an amount of torsional stress between the central portion and the distal portion, wherein each distal portion comprises about 25 percent or less of a total length of the blade.

2. The blade of claim **1**, wherein the non-zero leading angle is about twenty-five to about thirty-five degrees and wherein the camber percentage is about 2 to about 12 percent.

3. The blade of claim **1**, wherein the distal portion is curved about an edge furthest from the rotational axis based at least in part on a curve associated with a baffle surrounding the blade when attached to the motor.

4. The blade of claim **1**, wherein the camber percentage varies along a width of the blade such that at least a portion of a leading edge of the blade located within the distal portion is substantially flat.

5. The blade of claim **1**, wherein the distal portion is swept backwards to one or more of:

vary linearly with respect to a radius of the blade, or

curve along the radius.

6. The blade of claim **1**, wherein the blade is further defined by one or more of a leading edge or a trailing edge and wherein one or more of the leading edge or the trailing edge is tapered.

7. The blade of claim **1**, wherein the blade is further defined by a thickness and a chord width, and wherein the chord width is based at least in part on the thickness.

8. The blade of claim **7**, wherein the chord width is about two to about three inches.

9. The blade of claim **1**, wherein the flat central portion include a central opening and one or more peripheral openings configured for coupling the blade to a motor.

10. The blade of claim **1**, wherein a leading edge of the distal portion is sharpened.

11. A blade, comprising:

a substantially flat central portion having a rotational axis configured to be coupled to a motor for rotating the blade;

a distal portion extending radially from opposing sides of the flat central portion, the distal portion being a cutting region of the blade when mowing and defined by the following:

a non-zero leading angle defining an angle of attack; and

a non-zero camber percentage; and

an intermediate portion disposed between the central portion and each distal portion and configured to minimize an amount of torsional stress between the central portion and the distal portion.

12. The blade of claim **11**, wherein the non-zero leading angle at the distal portion is about 15 degrees to about 45 degrees.

13. The blade of claim **12**, wherein a chord width of the blade is substantially the same across a length of the blade.

14. The blade of claim **11**, wherein a width of the blade is about 2 to about 3 inches, and a thickness of the blade is about 0.15 inches to about 0.2 inches.

15. The blade of claim **11**, wherein an edge furthest from a rotational axis of the blade is curved.

16. A mower, comprising:

a plurality of wheels;

a deck assembly disposed between the plurality of wheels; and

a blade disposed in the deck assembly, the blade comprising:

a central portion having a rotational axis coupled to a motor for rotating the blade;

a distal portion extending from opposing sides of the central portion, the distal portion being a cutting region of the blade when mowing and defined by the following:

a non-zero leading angle defining an angle of attack; and

a non-zero camber percentage; and

an intermediate portion disposed between the central portion and the distal portion and configured to minimize an amount of torsional stress between the central portion and the distal portion.

17. The mower of claim **16**, wherein a gap between the blade and a cutting chamber of the deck assembly is about 0.03 to about 0.25 inches.

18. The mower of claim **16**, wherein each distal portion comprises about 25 percent or less of a total length of the blade.

19. The mower of claim **16**, further comprising a baffle disposed about the blade for controlling air flow within the deck assembly.

20. The mower of claim **16**, wherein the blade comprises a flat plate that is bent to form the distal portion and the intermediate portion.

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