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LAWN MOWER AND CUTTING DECK WITH DISCHARGE CHUTE CONTROL SYSTEM

Abstract

A lawn mower having a cutting deck with a chute control system having a moveable discharge chute. The discharge chute is adapted to move from an operative position to an inoperative position, whereby such movement results in corresponding movement of a blocking plate used to selectively block a discharge outlet of the cutting deck from an open position to a closed position, respectively.

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Background/Summary

[0001] The present application claims priority to and/or the benefit of U.S. Provisional Patent Application No. 63/337,690, filed May 3, 2022, which is incorporated herein by reference in its entirety. [0002] Embodiments of the present disclosure are related to lawn mowers, and more particularly, to cutting decks incorporating a movable grass discharge chute and associated control system.

BACKGROUND

[0003] Riding and walk-behind ground working vehicles such as lawn mowers are used by homeowners and professionals alike. These vehicles typically include a prime mover, e.g., one or more internal combustion engines and/or electric motors, to power not only an implement (e.g., cutting deck) attached to the vehicle, but also a traction drive system, the latter adapted to propel the vehicle over a ground surface.

[0004] Lawn mowers may generally include a discharge chute, e.g., side discharge chute, to direct clippings or other debris exiting the cutting deck. While effective at directing debris, the discharge chute may extend laterally in such a way that it interferes with the mower's ability to mow close to an edge of a work area and/or allow the mower to pass through narrow openings such as gates. For example, the discharge chute may hamper the ability to mow a portion of the work area immediately adjacent a building or other obstruction. Moreover, there may be instances in which the operator desires to block the mower's side discharge altogether, e.g., to prevent ejection of clippings into flower beds.

SUMMARY

[0005] Embodiments of the present disclosure may address these and other issues by providing, in one embodiment, a lawn mower including a cutting deck comprising a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet. A discharge chute is also provided and coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position. The mower further includes a blocking plate coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate. The discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.

[0006] In another embodiment, a lawn mower is provided that includes: a cutting deck having a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; and a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position. A blocking plate is coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate. A first gear is coupled to the discharge chute and a meshing second gear is coupled to the blocking plate, wherein the first gear rotates about a first axis and the second gear rotates about a second axis parallel to the first axis. The mower also includes an actuator configured to move at least one of the chute and the blocking plate.

[0007] In still another embodiment, a cutting deck is provided that includes: a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative

position and an operative position; and a blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate. The discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.

[0008] The above summary is not intended to describe each embodiment or every implementation. Rather, a more complete understanding of illustrative embodiments will become apparent and appreciated by reference to the following Detailed Description of Exemplary Embodiments and claims in view of the accompanying figures of the drawing.

Description

BRIEF DESCRIPTION OF THE VIEWS OF THE DRAWING

[0009] Exemplary embodiments will be further described with reference to the views of the drawing, wherein:

[0010] FIG. **1** is a left front perspective view of a lawn mower in accordance with embodiments of the present disclosure.

[0011] FIG. **2** is a right rear perspective view of a lawn mower consistent with the example of FIG. **1** and illustrating an exemplary discharge chute and chute control system of the present disclosure, the chute shown in an operative position.

[0012] FIG. **3** is a partial right front perspective view of a lawn mower and discharge chute consistent with the example of FIGS. **1-2**.

[0013] FIG. **4** is a partial right rear perspective view of a lawn mower and discharge chute consistent with the example of FIGS. **1-2**.

[0014] FIG. **5** is a right rear perspective view of a lawn mower consistent with the example of FIGS. **1-2** illustrating the discharge chute in an inoperative position, wherein an exemplary blocking plate is visible in a closed position corresponding to the inoperative position of the chute.

[0015] FIG. **6** is a front elevation view of a lawn mower consistent with the example of FIG. **5** illustrating the chute in the inoperative position (solid lines) and the operative position (broken lines).

[0016] FIG. **7** is a partial rear elevation view of a lawn mower consistent with the example of FIGS. **1-2** showing the discharge chute in the operative position.

[0017] FIG. **8** is a partial rear elevation view of the lawn mower consistent with the example of FIG. **7** but illustrating the discharge chute in the inoperative position and the blocking plate in a closed position.

[0018] FIG. **9** is a partial section view of the lawn mower taken along line **9-9** of FIG. **2** illustrating the discharge chute in the operative position and the blocking plate in the open position.

[0019] FIG. **10** is a partial section view similar to that of FIG. **9** but illustrating the discharge chute in the inoperative position and the blocking plate in the closed position.

[0020] FIG. **11** is a bottom plan view of a lawn mower consistent with the example of FIGS. **1-2** and illustrating the discharge chute in an operative position and the blocking plate in an open position.

[0021] FIG. **12** is an enlarged section view similar to that of FIG. **9** illustrating the chute in an operative position and the blocking plate in an open position.

[0022] The figures are rendered primarily for clarity and, as a result, are not necessarily drawn to scale. Moreover, various structure/components, including but not limited to fasteners, electrical components (wiring, cables, etc.), and the like, may be shown diagrammatically or removed from some or all of the views to better illustrate aspects of the depicted embodiments, or where inclusion

of such structure/components is not necessary to an understanding of the various exemplary embodiments described herein. The lack of illustration/description of such structure/components in a particular figure is, however, not to be interpreted as limiting the scope of the various embodiments in any way.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0023] In the following detailed description of illustrative embodiments, reference is made to the accompanying figures of the drawing which form a part hereof. It is to be understood that other embodiments, which may not be described and/or illustrated herein, are certainly contemplated.

[0024] All headings provided herein are for the convenience of the reader and should not be used to limit the meaning of any text that follows the heading, unless so specified. Moreover, unless otherwise indicated, all numbers expressing quantities, and all terms expressing direction/orientation (e.g., vertical, horizontal, parallel, perpendicular, etc.) in the specification and claims are to be understood as being modified in all instances by the term "about." Furthermore, the terms "having," "including," "comprises" and variations thereof do not have a limiting meaning where these terms appear in this description and claims, and the terms "a," "an," "the," "at least one," and "one or more" are used interchangeably herein. The term "and/or" (if used) means one or all of the listed elements or a combination of any two or more of the listed elements. "I.e." is used as an abbreviation for the Latin phrase id est and means "that is." "E.g.," is used as an abbreviation for Latin phrase exempli gratia and means "for example."

[0025] Still further, relative terms such as "left," "right," "front," "fore," "forward," "rear," "aft," "rearward," "top," "bottom," "side," "upper," "lower," "above," "below," "horizontal," "vertical," and the like may be used herein and, if so, are from the perspective of one operating the mower **100** while the mower is in an operating configuration, e.g., while it is positioned such that ground-engaging members (e.g., wheels) rest upon a generally horizontal ground surface **101** as shown in FIG. **1**. These terms are used only to simplify the description, however, and not to limit the interpretation of any embodiment described.

[0026] Embodiments described and illustrated herein are directed to lawn mowers incorporating a cutting deck. The deck may define a discharge outlet and include an associated discharge chute control system for controlling one or both of: a discharge chute coupled to the deck and adapted to selectively direct debris ejected from the discharge outlet; and a blocking plate coupled to the deck and adapted to selectively open and close the discharge outlet. For example, the discharge chute may be moveable between an inoperative position and an operative position, while the blocking plate may be moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate. In exemplary embodiments, the discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute or the blocking plate.

[0027] Repositioning the discharge chute and blocking plate can be accomplished manually or automatically. For example, in one or more embodiments, the mower can include various manually powered actuators (e.g., a lever, cable) that can be manipulated by an operator to move the discharge chute and blocking plate as described herein. In other embodiments, the mower can include one or more powered actuators (e.g., electrically, pneumatically, or hydraulically powered actuator) that can be selectively energized (e.g., by the mower operator) to produce movement of the discharge chute and blocking plate. In still other embodiments, the mower may include one or more controllers that automatically control a powered actuator(s) to move the discharge chute and/or the blocking plate. Such automation may be useful, for example, with application to remotely-controlled or autonomous mowers.

[0028] With reference to the figures of the drawing, wherein like reference numerals designate like parts and assemblies throughout the several views, FIG. **1** illustrates a self-propelled vehicle, e.g., a riding lawn mower **100**, including a cutting deck **200** (e.g., belly-mounted deck) having a discharge

chute **300** (see also FIG. **2**). While, for the sake of brevity, embodiments of the disclosure are herein described with reference to a sit-on mower (hereinafter generically referred to simply as a "mower"), those of skill in the art will realize that the concepts described herein are equally applicable to other types of walk-behind and stand-on mowers, as well as to most any other walk-behind, sit-on, stand-on, remotely-controlled, or autonomous ground working vehicle having a ground-engaging implement incorporating a discharge outlet.

[0029] It is noted that the reference numeral suffixes "a" and "b" may be used throughout this description to denote various left- and right-side parts/features, respectively. However, in most pertinent respects, the parts/features denoted with "a" and "b" suffixes are substantially identical to, or mirror images of, one another. It is understood that, unless otherwise noted, the description of an individual part/feature (e.g., part/feature identified with an "a" suffix) also applies to the opposing part/feature (e.g., part/feature identified with a "b" suffix). Similarly, the description of a part/feature identified with no suffix may apply, unless noted otherwise, to both the corresponding left and right part/feature.

[0030] While not necessarily central to an understanding of exemplary embodiments of the present disclosure, the general construction of the illustrative mower **100** is now briefly described. As shown in FIG. **1**, the mower **100** may include a frame or chassis **102** having a front end F and a rear end R, the chassis **102** supporting a power source or prime mover (not shown) such as one or more internal combustion engines and/or one or more electric motors. For example, one engine could power both the cutting deck and a vehicle propulsion system (e.g., the engine could power a hydrostatic pump connected to separate drive wheel motors). In other embodiments, multiple electric motors may be used to separately power the cutting deck (e.g., one motor powering all blade spindles, or a separate motor powering each spindle) and the propulsion system (e.g., one motor powering a single transaxle, or separate motors powering each drive wheel).

[0031] A pair of transversely opposing, ground-engaging drive members, e.g., first and second (left and right) rear drive wheels **106** (e.g., a left wheel **106***a* and a right wheel **106***b*) as shown in FIG. **2**, may be coupled to opposite (left and right) rear sides of the chassis **102** to support the mower **100** upon, and propel the mower **100** relative to, the ground surface **101**.

[0032] Operator controls may permit independent control of the speed and direction of each drive wheel **106**, allowing operator control of mower **100** speed and direction from an operator platform, e.g., an operator seat **112**. The operator controls may include drive control levers **114** (e.g., a left drive control lever **114***a* and a right drive control lever **114***b*) operable to independently control speed and direction of their respective drive wheels **106** via manipulation of the mower's drive system as is known in the art. While illustrated herein as incorporating separate drive control levers **114**, other controls, e.g., single or multiple joysticks or joystick-type levers, steering wheels, etc. may also be used without departing from the scope of this disclosure. The mower **100** may further include various other controls (power take-off (PTO) engagement, ignition, throttle, etc.), as are known in the art. While shown as incorporating various operator controls, such embodiments are not limiting as embodiments of the present disclosure may also be utilized with mowers lacking some or all on-board controls, e.g., mowers intended for remote control operation and/or autonomous operation.

[0033] A pair of front ground-engaging members or wheels **104** (e.g., a left caster wheel **104***a* and a right caster wheel **104***b*), which may be connected to forwardly extending portions of the chassis **102**, may support a front portion of the mower **100** in rolling engagement with the ground surface **101**. Although the illustrated mower **100** has the drive wheels **106** towards the rear of the chassis **102** and the caster wheels **104** towards the front, this configuration is not limiting. For example, other embodiments may reverse the location of the wheels, e.g., the drive wheels in front and the driven or undriven wheels in back. Moreover, other configurations may use different wheel configurations altogether, e.g., a tri-wheel configuration or a vehicle having conventionally-steered wheels. Moreover, while illustrated herein as wheels, other ground-engaging members (e.g., tracks,

skids, rollers, etc.) are also contemplated.
[0034] The mower **100** may further include the mower cutting deck **200** mounted to a lower side of the chassis **102**, e.g., generally between the drive wheels **106** and the caster wheels **104**. The cutting deck **200**, which is described in more detail below, may form a deck housing defining at least one downwardly-opening and partially enclosed cutting chamber **202** as shown in FIG. **11**. Within each cutting chamber **202** (e.g., a center chamber **202**C, a right chamber **202**R, and a left chamber **202**L) may be one or more rotatable cutting blades **204** (e.g., a center blade **204**C, a right blade **204**R, and a left blade **204**L), each attached to a rotatable blade spindle **206** (e.g., a center spindle **206**C, a right spindle **206**R, and a left spindle **206**L) journaled to the respective deck housing. Once again, while illustrated herein as a belly-mount deck, other mower configurations may, alternatively or in addition, utilize other deck configurations (e.g., an out-front or rear-mounted (e.g., towed) deck, a laterally-mounted deck).
[0035] During operation, power may be selectively provided by the prime mover(s) to at least one of the cutting deck **200** (e.g., to the spindles **206**) and the drive wheels **106**, whereby the cutting blades rotate at a speed sufficient to sever grass and other vegetation as the deck passes over the ground surface **101**. Typically, the mower **100** includes an operator-selectable height-of-cut control system **116** (e.g., a deck lift pedal **116***c* and a deck position lever **116***d*, see FIG. **1**) to allow deck height adjustment relative to the ground surface **101**.
[0036] As illustrated in FIG. **1**, the cutting deck **200** may include a top surface **212** and at least one sidewall **214** extending downwardly therefrom, where the top surface **212** and the at least one sidewall **214** together form the cutting chamber(s) **202** that open in a downwardly-facing direction (e.g., towards the ground surface **101** during operation). The at least one sidewall **214** may wrap around a perimeter of the top surface **212** such that the at least one sidewall **214** surrounds the cutting chamber(s) **202**. In some embodiments, the at least one sidewall **214** defines a discharge outlet **216** (as illustrated in FIGS. **9** and **11**). The discharge outlet **216** may be positioned such that grass clippings and other debris may be ejected in a certain direction from the cutting chamber(s) **202** during mower operation. While the position of the discharge outlet **216** may be at most any location along the sidewall(s) (e.g., along a left side of the deck or along a rear side of the deck, etc.), it may in some embodiments be positioned along the right side of the deck as shown in FIG. **2**.
[0037] The discharge outlet **216** may define a window through the at least one sidewall **214** of most any size that effectively permits the desired flow of debris (e.g., grass clippings) through the discharge outlet. As indicated above, other mowers **100** may locate the cutting deck **200** and the discharge outlet **216** at other locations relative to the chassis **102** (e.g., a forwardly-mounted or "out-front" deck, towed deck, or laterally-mounted deck).
[0038] With this general overview of an exemplary mower and cutting deck, discharge chute systems in accordance with embodiments of the present disclosure are now described with initial reference to FIGS. **2** and **5**. As shown in FIG. **2**, the discharge chute ("chute") **300**, may be coupled to the cutting deck **200** such that the chute **300** may effectively guide ejected debris during cutting deck operation when the chute is in the operative position as shown in FIG. **2**. As further described below, the chute **300** may be moved between at least this operative position as shown in FIG. **2** and the inoperative position as shown in FIG. **5**. When the chute **300** is in the operative position, the chute **300** may be connected or joined to the discharge outlet **216** to effectively guide debris exiting the discharge outlet **216**, while in the inoperative position, the chute may be disconnected or disjoined from the discharge outlet **216**.
[0039] To permit chute motion relative to the deck, the chute **300** may be coupled to the cutting deck **200** using any most means known in the art (e.g., bolts, hinges, pins, slides, etc.) that permits the desired motion. While the shape of the chute **300** may vary, it may in some embodiments form an inverted (downwardly-opening) generally U-shaped channel adapted to guide debris ejected through the discharge outlet **216** (see FIG. **11**) from the cutting chamber(s) **202**.

[0040] The chute **300** may be of most any suitable shape that effectively guides grass clipping and other debris out from beneath mower **100**, e.g., out from the cutting chamber(s) of the cutting deck **200**. As illustrated in FIG. **7**, the chute **300** may, in some embodiments, slope downwardly and away from the cutting deck when the chute **300** is in the operative position. Moreover, in the operative position, the chute **300** may be suspended above the ground surface **101** so that it does not drag along the ground surface during mower operation. As stated above, the chute **300** may be generally U-shaped having a chute top wall **306** and at least one (e.g., two) chute sidewall **308**. The chute top wall **306** and the chute sidewalls **308** may abut, or may otherwise be positioned close to, the sidewall **214** (around the discharge outlet **216**) when the chute is in the operative position.
[0041] The chute **300** may extend generally along a chute axis **400** as illustrated in FIGS. **6** and **11**. As used herein, "chute axis **400**" may refer to an axis that extends from an inner end of the chute **300** (proximate the sidewall **214**) to an opposite (distal or outer end) of the chute **300** (distal to the at least one sidewall **214**). In the illustrated embodiments, the chute **300** is pivotally coupled to the cutting deck **200** (e.g., above and proximate the discharge outlet **216**) about a first axis **410** as shown in FIG. **9**. As a result, as the chute **300** is pivoted from the operative position (broken line rendering in FIG. **6**) to the inoperative position (solid line rendering in FIG. **6**), the chute axis **400** moves between the two positions illustrated. While not wishing to be bound to a specific chute axis, it may in some embodiments be described as extending orthogonal to the first axis **410**.
[0042] As shown in FIG. **6**, when the chute **300** is in the operative position, the chute **300** (e.g., the chute axis **400**) could extend in a generally horizontal direction (parallel with the ground surface **101**). However, in other embodiments, the operative position may not be horizontal, but may instead extend at a downward (or, alternatively, upward) angle relative to horizontal (e.g., up to +/−45 degrees from horizontal, or up to +/−15 degrees from horizontal).
[0043] As stated above, when the chute **300** is in the inoperative position, it is not intended to guide debris exiting the discharge outlet **216**, but rather is positioned to reduce interference with surrounding obstacles. For instance, in the inoperative position, the chute **300** (e.g., the chute axis **400**) may be positioned such that it extends generally orthogonally with respect to the ground surface **101**. In other exemplary embodiments, however, the chute/chute axis may extend upwardly at a non-orthogonal angle from the ground surface **101** when in the inoperative position. Regardless, the inoperative position may allow the chute **300** to avoid contact with obstacles that the chute **300** may otherwise encounter if in the operative position. Exemplary non-orthogonal angles of the chute axis **400** (when the chute is in the inoperative position) may be any angle up to 180 degrees from the operative position (e.g., folded over onto the top surface **212** of the deck). In other embodiments, the chute axis **400** may form an angle of between 75 degrees and 105 degrees from horizontal when in the inoperative position.
[0044] As shown in FIG. **5**, a blocking plate **302** may also be coupled (e.g., pivotally coupled) to the cutting deck **200** using any pivotal means known in the art (e.g., bolts, hinges, pins, etc.). In the illustrated, embodiments, the blocking plate **302** may be coupled to the cutting deck **200** (e.g., to the top surface **212** or sidewall **214**) proximate the discharge outlet **216** such that the blocking plate **302** is able to selectively block the discharge outlet **216** when in a closed position as shown in FIG. **5**, and permit passage of debris when in an open position as shown in FIG. **9**.
[0045] As shown in FIG. **5**, when the chute **300** is in the inoperative position, the blocking plate **302** may be in the closed position such that the blocking plate **302** obstructs, blocks, or otherwise occludes the discharge outlet **216**. Conversely, when the chute **300** is in the operative position shown in FIG. **9**, the blocking plate **302** may be in the open position such that the blocking plate **302** does not block the discharge outlet **216**, permitting debris to freely exit the discharge outlet **216** via the chute **300**.
[0046] As further shown in FIG. **9**, when in the open position, the blocking plate **302** may extend outwardly beyond the at least one sidewall. For example, as discussed above with respect to the chute **300**, the blocking plate **302** may extend in a generally horizontal direction (parallel with the

ground surface **101**) when the blocking plate **302** is in the open position and may extend generally orthogonally to the ground surface **101** when in the closed position. However, in other embodiments, the open position may instead extend at an angle downwards or upwards relative to horizontal (e.g., up to +/−45 degrees from horizontal, or up to +/−15 degrees from horizontal). When in the closed position, the blocking plate **302** may be at most any angle relative to horizontal that permits the blocking plate to effectively block the discharge outlet. While shown as being generally planar, the blocking plate may be of most any shape (e.g., curved) that suitably blocks the discharge outlet when in the closed position.

[0047] As stated above, the chute **300** may be pivotally coupled to the cutting deck **200** about the first axis **410** as shown in FIGS. **9** and **10**. Similarly, the blocking plate **302** may be pivotally coupled to the cutting deck **200** about a second axis **412** that is offset from and parallel to the first axis **410**. In the illustrated embodiments, the first axis **410** and the second axis **412** may be generally transverse to the chute axis **400**, and they may be parallel to the ground surface **101**.

[0048] As shown in FIGS. **9-10** the chute **300** and the blocking plate **302** may include a first gear **310** and a second gear **312**, respectively, wherein the first gear is adapted to rotate about the first axis **410** and the second gear is adapted to rotate about the second axis **412**. That is to say, the first gear **310** may be operatively coupled to the discharge chute **300** (e.g., be integrally formed with or otherwise attached to the chute), while the second gear **312** is operatively coupled to the blocking plate **302** such that each gear moves in direct relation with its attached component. Moreover, the first gear **310** and the second gear **312** may mesh with one another such that rotation of one gear produces corresponding rotation in the other, and vice versa. Stated alternatively, as either one of the chute **300** or the blocking plate **302** moves, corresponding movement of the other will result due to the meshing of the first gear **310** and the second gear **312** as further described below. Accordingly, the chute **300** may be characterized as being operatively connected to the blocking plate **302** such that movement of one causes movement of the other.

[0049] In illustrated embodiments, the first gear **310** and the second gear **312** have identical constructions (pitch diameters) such that the chute **300** and the blocking plate **302** rotate in a 1:1 ratio (e.g., if the chute **300**/first gear **310** moves 90 degrees, the blocking plate **302**/second gear **312** also move 90 degrees). In alternative embodiments, the two gears may have different geometries to allow a different angular rotations of either the chute or the blocking plate relative to the other.

[0050] In the illustrated embodiments, the first gear **310** and the second gear **312** may have an elongate shape. Such a gear configuration may allow reduced pressure on the gear teeth, allowing the gears to be constructed of inexpensive materials such as injection molded plastic or extruded aluminum. However, such an elongate structure is exemplary only as more convention gears are certainly possible without departing from the scope of this disclosure.

[0051] Movement of the chute **300** and the blocking plate **302** may be initiated and controlled manually. For example, a user may directly or manually move the chute **300** between the operative and the inoperative positions (or, alternatively, the blocking plate **302** between the open and closed positions), thus causing the blocking plate **302** to move between the open and closed positions (or, if the blocking plate **302** is moved, causing the chute **300** to move between the operative and inoperative positions). However, in other embodiments, the mower **100** may include an actuator connected to the chute **300** and/or blocking plate **302**, whereby the actuator may, upon operator manipulation, cause movement of at least one of the chute **300** and the blocking plate **302**.

[0052] As illustrated in FIGS. **2-4**, the actuator may include a pivot arm **314**, a handle **502** attached to the pivot arm, and a pin **318** affixed to the chute **300**, e.g., via a bracket **315**. As further illustrated in FIGS. **7**, **8**, and **12**, the pivot arm **314** may define a slot **316**. The pivot arm may be pivotally coupled to the cutting deck **200** (e.g., to the top surface **212**) such that it may pivot relative to the cutting deck about a third axis **418** (see FIG. **4**). While not wishing to be bound to any specific orientation, the third axis **418** may be oriented orthogonal to a direction of the first axis **410** and/or the second axis **412**.

[0053] The pivot arm **314**/handle **502** may be moveable between a first position and a second position. The first position of the pivot arm **314** may correspond to the chute **300** being in the operative position and the blocking plate **302** being in the open position (see, for example, FIGS. **2**, **4**, **7**, and **9**). The second position of the pivot arm **314**/handle **502** may correspond to the chute **300** being in the inoperative position and the blocking plate **302** being in the closed position (see, e.g., FIGS. **5**, **8**, and **10**).
[0054] The slot **316** of the pivot arm **314** may be configured to receive the pin **318**. As stated above, the pin may be fixed to the bracket **315** which is, in turn, fastened or attached to (or alternatively, integrally formed as part of) the chute **300**. The pin **318** may move freely within the slot between the slot ends. As shown in FIG. **9**, the pin **318** may be offset from the first axis **410** such that movement of the pin may produce movement of the chute **300** about the first axis.
[0055] During operation, the operator may manipulate the handle **502**/pivot arm **314** by pivoting the handle **502** from the first position (see FIG. **7**) to the second position (see FIG. **8**). As the handle **502** and pivot arm **314** pivot about the third axis **418** (see FIG. **4**), the slot **316** moves downwardly. As the slot **316** moves, the pin **318** will translate along the slot **316** from the position shown in FIG. **7** to the position shown in FIG. **8**. As the pin **318** is attached to the bracket **315**, such movement of the pin causes desired rotation of the chute **300** from the operative to the inoperative position.
[0056] This motion is further depicted in FIG. **12**, wherein the pivot arm **314**, slot **316**, and pin **318** are shown in solid lines for the first position of the handle, and in broken lines for the second position of the handle. As is evident in this view, as the pivot arm **314** pivots about the third axis **418** (see FIG. **4**), the pivot arm **314**, the pin **318**, and the slot **316** move between the solid line position and the broken line position. That is to say, pivotal movement of the pivot arm causes the slot to move downwardly as shown. As the pin **318** (connected to the chute **300**) is constrained to move only within the slot **316**, the pin **318** moves through an arc of motion **319** about the first axis **410** (due to the pin being spaced from the first axis by a distance **320**). Such movement causes the first gear **310** to rotate and accordingly the chute to move from the operative to the inoperative positions. Moreover, as the first gear **310** meshes with the second gear **312** of the blocking plate **302**, the blocking plate also moves to the closed position as a result of the movement of the pin **318**.
[0057] As shown in FIGS. **7** and **8**, the chute control system may include one or more biasing members, e.g., extension springs, that assist in biasing the chute and/or the blocking plate toward one or both of their respective positions. For example, an extension spring **322** may have a first end coupled to a sidewall of the cutting deck **200** (as illustrated in FIGS. **1** and **2**) and a second end coupled to the bracket **315** as shown. When the chute **300** is in the operative position as shown in FIG. **7**, the spring **322** biases the chute in the clockwise direction (as viewed in FIG. **7**) about the first axis **410**, thereby biasing the chute to its operative position (and thus the blocking plate to its open position). However, as shown in FIG. **8**, when the chute **300** is in the inoperative position, the spring **322** may apply a force to the chute in the counterclockwise direction (as viewed in FIG. **8**) about the first axis **410**, thereby biasing the chute to its inoperative position (and thus the blocking plate to its closed position). That is to say, the spring **322** may connect to the chute (e.g., to the bracket **315**) such that its over-center movement (relative to the first axis **410**), allows it to bias or hold the chute in both positions. While illustrated as a single spring connected to the bracket **315**, such an embodiment is exemplary only as other biasing devices, and other attachment configurations, are certainly possible.
[0058] While described as moving the handle back and down to initiate chute/blocking plate movement, such a construction is exemplary only. In other embodiments, the handle may be configured to move in the reverse direction to effectuate such movement, move side-to-side, rotate, translate, or move in most any other manner that causes the desired slot movement. In other embodiments, chute motion may occur with other actuators controlled by the operator's hand or

foot.
[0059] In exemplary embodiments described above, movement of the chute **300** and the blocking plate **302** may be initiated and controlled by manual actuation. In other embodiments, other actuators may be provided to initiate and control movement of at least one of the chute **300** and the blocking plate **302**. For example, the actuator may be configured as a cable and/or a link or linkages operatively connected to the chute **300** or the blocking plate **302**. In still other embodiments, the actuator may be a powered actuator, e.g., a pneumatic, hydraulic, or electrical actuator, solenoid, or motor capable of producing linear or rotational output. Such actuator may be controlled by an operator input (e.g., switch, button, pedal, valve, or the like).
[0060] In yet other embodiments, the mower **100** may also include an electronic controller, whereby the controller may control the powered actuator. As with the powered actuators described above, the controller may be coupled to the operator input (e.g., switch, button, pedal, valve, or the like) used to energize the actuator.
[0061] In still other embodiments, movement of the chute **300** and the blocking plate **302** may be initiated and controlled automatically without user input. For example, the mower **100** may include a sensor or sensors, such as one or more cameras, or one or more motion sensors. Such sensors may sense an object in the path of the mower **100** (or in the path of the chute **300**) and send a signal or signals to the controller. The controller may then energize the actuator to initiate or control movement of the chute **300** and the blocking plate **302** in response to the sensor signal(s). Such a configuration may be suitable for autonomous mowing operations.
[0062] Various illustrative embodiments are within the scope of this disclosure, some examples of which are identified below.
[0063] Embodiment 1. A lawn mower comprising: a cutting deck comprising a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; and a blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate, wherein the discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.
[0064] Embodiment 2. The lawn mower of embodiment 1, wherein the discharge chute, when in the operative position, is joined to the discharge outlet to effectively guide debris exiting the discharge outlet, and when in the inoperative position, is disjoined from the discharge outlet.
[0065] Embodiment 3. The lawn mower of embodiment 2, wherein the discharge chute defines a chute axis, wherein the chute axis extends: in a first direction when the discharge chute is in the operative position; and in a second direction when the discharge chute is in the inoperative position.
[0066] Embodiment 4. The lawn mower of any one of embodiments 1-3, wherein the blocking plate is coupled to the cutting deck proximate the discharge outlet.
[0067] Embodiment 5. The lawn mower of any one of embodiments 1-4, wherein the discharge chute is pivotally coupled to the cutting deck about a first axis and the blocking plate is pivotally coupled to the cutting deck about a second axis parallel to the first axis.
[0068] Embodiment 6. The lawn mower of embodiment 5, further comprising a first gear associated with the discharge chute and a meshing second gear associated with the blocking plate, wherein the first gear rotates about the first axis and the second gear rotates about the second axis.
[0069] Embodiment 7. The lawn mower of any one of embodiments 1-6, further comprising an actuator configured to move at least one of the discharge chute and the blocking plate.
[0070] Embodiment 8. A lawn mower comprising: a cutting deck comprising a top surface and at

least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; a blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate; a first gear coupled to the discharge chute and a meshing second gear coupled to the blocking plate, wherein the first gear rotates about a first axis and the second gear rotates about a second axis parallel to the first axis; and an actuator configured to move at least one of the chute and the blocking plate.
[0071] Embodiment 9. The lawn mower of embodiment 8, wherein the actuator comprises: a pivot arm coupled to the cutting deck and configured for movement relative thereto, the pivot arm defining a slot configured to receive a pin associated with the discharge chute, the pin offset from the first axis.
[0072] Embodiment 10. The lawn mower of embodiment 9, wherein the pivot arm is pivotally coupled to the cutting deck for pivoting about a third axis, the third axis oriented orthogonal to a direction of the first axis.
[0073] Embodiment 11. The lawn mower of any one of embodiments 9-10, wherein the actuator further comprises a handle operatively connected to the pivot arm.
[0074] Embodiment 12. The lawn mower of any one of embodiments 8-11, wherein the discharge chute, when in the operative position, is joined to the discharge outlet to effectively guide debris exiting the discharge outlet, and when in the inoperative position, is disjoined from the discharge outlet.
[0075] Embodiment 13. The lawn mower of any one of embodiments 8-12, wherein the discharge chute defines a chute axis, wherein the chute axis extends: in a first direction when the discharge chute is in the operative position; and in a second direction when the discharge chute is in the inoperative position.
[0076] Embodiment 14. The lawn mower of any one of embodiments 8-13, wherein the blocking plate is coupled to the cutting deck proximate the discharge outlet.
[0077] Embodiment 15. A cutting deck comprising: a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; and a blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate, wherein the discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.
[0078] Illustrative embodiments are described, and reference has been made to possible variations of the same. These and other variations, combinations, and modifications will be apparent to those skilled in the art, and it should be understood that the claims are not limited to the illustrative embodiments set forth herein.

Claims

1. A lawn mower comprising: a cutting deck comprising a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; and a blocking plate also coupled to the cutting deck and moveable between an

open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate, wherein the discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.

2. The lawn mower of claim 1, wherein the discharge chute, when in the operative position, is joined to the discharge outlet to effectively guide debris exiting the discharge outlet, and when in the inoperative position, is disjoined from the discharge outlet.

3. The lawn mower of claim 2, wherein the discharge chute defines a chute axis, wherein the chute axis extends: in a first direction when the discharge chute is in the operative position; and in a second direction when the discharge chute is in the inoperative position.

4. The lawn mower of claim 1, wherein the blocking plate is coupled to the cutting deck proximate the discharge outlet.

5. The lawn mower of **1**, wherein the discharge chute is pivotally coupled to the cutting deck about a first axis and the blocking plate is pivotally coupled to the cutting deck about a second axis parallel to the first axis.

6. The lawn mower of claim 5, further comprising a first gear associated with the discharge chute and a meshing second gear associated with the blocking plate, wherein the first gear rotates about the first axis and the second gear rotates about the second axis.

7. The lawn mower of **1**, further comprising an actuator configured to move at least one of the discharge chute and the blocking plate.

8. A lawn mower comprising: a cutting deck comprising a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; a blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate; a first gear coupled to the discharge chute and a meshing second gear coupled to the blocking plate, wherein the first gear rotates about a first axis and the second gear rotates about a second axis parallel to the first axis; and an actuator configured to move at least one of the chute and the blocking plate.

9. The lawn mower of claim 8, wherein the actuator comprises: a pivot arm coupled to the cutting deck and configured for movement relative thereto, the pivot arm defining a slot configured to receive a pin associated with the discharge chute, the pin offset from the first axis.

10. The lawn mower of claim 9, wherein the pivot arm is pivotally coupled to the cutting deck for pivoting about a third axis, the third axis oriented orthogonal to a direction of the first axis.

11. The lawn mower of claim 9, wherein the actuator further comprises a handle operatively connected to the pivot arm.

12. The lawn mower of claim 8, wherein the discharge chute, when in the operative position, is joined to the discharge outlet to effectively guide debris exiting the discharge outlet, and when in the inoperative position, is disjoined from the discharge outlet.

13. The lawn mower of claim 8, wherein the discharge chute defines a chute axis, wherein the chute axis extends: in a first direction when the discharge chute is in the operative position; and in a second direction when the discharge chute is in the inoperative position.

14. The lawn mower of claim 8, wherein the blocking plate is coupled to the cutting deck proximate the discharge outlet.

15. A cutting deck comprising: a top surface and at least one sidewall that together form a downwardly opening cutting chamber, the at least one sidewall defining a discharge outlet; a discharge chute coupled to the cutting deck and positioned proximate the discharge outlet, wherein the discharge chute is movable between an inoperative position and an operative position; and a

blocking plate also coupled to the cutting deck and moveable between an open position, wherein the discharge outlet is unobstructed by the blocking plate, and a closed position, wherein the discharge outlet is obstructed by the blocking plate, wherein the discharge chute is operatively connected to the blocking plate such that movement of either the discharge chute or the blocking plate produces corresponding movement of the other of the discharge chute and the blocking plate.