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Speed control assembly

Abstract

A mower including a handle assembly and a grip coupled to the handle assembly. The handle assembly includes a cross member. The grip is moveable longitudinally relative to the cross member. The mower also includes a sensor operable to generate an output signal based on a position of the grip relative to the cross member, and a drive assembly configured to operate based on the output signal.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 18/188,036, filed Mar. 22, 2023, which is a continuation of U.S. patent application Ser. No. 16/624,200, now U.S. Pat. No. 11,690,319, filed Dec. 18, 2019, which claims the benefit of International Application No. PCT/US2018/038970, filed on Jun. 22, 2018, which claims priority to U.S. Provisional Patent Application No. 62/524,179 filed on Jun. 23, 2017, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION
(1) The present invention relates to a speed control system, and more particularly to a speed control system for a lawn mower.
SUMMARY OF THE INVENTION
(2) The present invention provides, in one aspect, a mower including a handle assembly, a grip moveable relative to the handle assembly, a sensor operable to generate an output signal based on a position of the grip relative to the handle assembly, a drive assembly, and a controller coupled to the sensor and the drive assembly. The controller receives the output signal and controls the drive assembly according to the output signal.
(3) The present invention provides, in another aspect, a mower including an upper arm, a cross member coupled to the upper arm, and a housing coupled to the cross member and the upper arm. The mower further includes a grip at least partially received within the housing. The grip is movable relative to the housing. A biasing member biasing the grip, and the biasing member is at least partially positioned within the housing. A sensor is positioned within the housing, and the sensor generates a control signal based on the position of the grip with respect to the housing. The mower further includes a controller that receives the control signal and operates the mower based on the control signal.
(4) The present invention provides, in another aspect, a mower including a deck defining a handle pivot axis, a drive system, a handle member coupled to the deck and rotatable with respect to the deck about the handle pivot axis, a lower arm coupled to the handle member, a upper arm telescopically coupled to the lower arm, and a speed control assembly. The speed control assembly includes a housing coupled to the upper arm and a grip at least partially received within the housing and movable relative to the upper arm. The speed control assembly further includes a sensor positioned within the housing. The sensor detecting displacement of the grip relative to the upper arm and generating a control signal. A controller receives the control signal and operates the drive system based on the control signal.
(5) Other features and aspects of the invention will become apparent by consideration of the following detailed description and accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view of a lawn mower including a speed control assembly in accordance with an embodiment of the invention.
(2) FIG. **2** is a partial section view of the lawn mower of FIG. **1** taken along the line **2-2** shown in FIG. **1**.
(3) FIG. **3** is a front view of the lawn mower and the speed control assembly of FIG. **1**.
(4) FIG. **4**A is a section view of the speed control assembly taken along the line of **4**A-**4**A shown in FIG. **3**, illustrating a grip of the speed control assembly in a first position.
(5) FIG. **4**B is another section view of the speed control assembly and taken along the line of **4**A-**4**A shown in FIG. **3**, illustrating the grip of the speed control assembly in a second position.
(6) FIG. **5** is a perspective view of a speed control assembly in accordance with another embodiment of the invention.
(7) FIG. **6** is a perspective view of a speed control assembly in accordance with another embodiment of the invention.
(8) FIG. **7** is a front view of a speed control assembly in accordance with another embodiment of the invention.
(9) Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.
DETAILED DESCRIPTION
(10) FIGS. **1** and **2** illustrate a lawn mower **10** including a handle assembly **14** pivotally coupled to a main body **18** that supports a drive system assembly **22** (FIG. **2**). The drive system **22** includes, for example, an electric motor **24** powered by a battery pack **80** received within the main body **18**. The motor **24** drives a set of wheels **26**, which support the main body **18** for movement over a surface. In the illustrated embodiment, the rear wheels **26** are driven by the drive system **22**, but alternative embodiments include both the front and the rear wheels being driven by the drive system **22**. A transmission is coupled to the motor **24** to reduce the rotational speed from the motor **24** and to transfer the motor torque to the wheels **26**. The mower **10** further includes a cutting element **28** rotationally supported on a mower deck **20** positioned beneath the main body **18**. The cutting element **28** is ultimately driven by the motor **24**. In alternative embodiments, the cutting element **28** may be driven by a motor separate from the motor that drives the wheels **26**. As described in greater detail below, the mower **10** also includes a speed control assembly **30** that controls the operation of the drive system **22**. More specifically, the speed control assembly **30** automatically controls the ground travel speed of the lawn mower **10** based on a user's walking pace.
(11) With continued reference to FIGS. **1** and **2**, the handle assembly **14** is pivotally coupled to the main body **18** such that the handle assembly **14** may be rotated between discrete positions relative to the main body **18**. The handle assembly **14** includes a pair of lower arms **35** and a pair of upper arms **32**. The pair of upper arms **32** include a first upper arm **33** operable to translate along a first longitudinal axis **433** and a second upper arm **34** operable to translate along a second longitudinal axis **434**. In the illustrated embodiment, the first longitudinal axis **433** is parallel to the second longitudinal axis **434**. The handle assembly **14** further includes a cross member **62** that extends transversely between the first upper arm **33** and the second upper arm **34** to, among other things, provide lateral support for the handle assembly **14**. In the illustrated embodiment, the cross member **62** is integral with the upper arms **32** at an upper end **33***a* of the first upper arm **33** and integral with an upper end **34***a* of the second upper arm **34**. In particular, a first corner **63** is formed at the

connection of the first upper arm **33** and the cross member **62**, and a second corner **64** is formed at the connection of the second upper arm **34** and the cross member **62**. In other embodiments, the cross member **62** is removably coupled to the pair of upper arms **32**. The pair of upper arms **32** are telescopically received by the pair of lower arms **35** through a first adjustment connector **44** and a second adjustment connector **45**. In other words, the distance the upper arms **32** extend away from lower arms **35** is adjustable by a user via the connectors **44**, **45**.

(12) The pair of lower arms **35** includes a first lower arm **36** and a second lower arm **37**. The first lower arm **36** is coupled to a first offset arm handle member **39**, and the second lower arm **37** is coupled to a second offset arm handle member **40**. The first offset arm **39** is pivotally coupled to a first bracket **41** of the mower deck **20** about a first handle pivot axis **441**. Likewise, the second offset arm **40** is pivotally coupled to a second bracket **42** of the mower deck **20** about a second handle pivot axis **442**. The handle assembly **14** also includes a locking mechanism **38** coupled to the pair of lower arms **35** to releasably retain the handle assembly **14** at various pivoted positions relative to the main body **18**. In other words, the locking mechanism **38** is operable to secure the handle assembly **14** in various positions (e.g., a storage position, a vertical position, a small-angle position, a large-angle position, etc.) relative to the main body **18**.

(13) With reference to FIG. **3**, the speed control assembly **30** includes a U-shaped grip **46** with a gripping portion **50** and a pair of grip legs **54**, including a first grip leg **55** and a second grip leg **56**. The gripping portion **50** is oriented substantially parallel to the cross member **62**, and the gripping portion **50** extends the entire width of the cross member **62**. The first grip leg **55** is slidably coupled to the first upper arm **33**, and the second grip leg **56** is slidably coupled to the second upper arm **34**. As such, the grip **46** is moveable relative to the handle assembly **14**. A bail control **57** is also positioned on the grip **46**.

(14) With continued reference to FIGS. **2-3**, the speed control assembly **30** further includes a first housing **60** and a second housing **61**. Both the first housing **60** and the second housing **61** are formed as clam-shell housings that partially enclose the grip **46** and the handle assembly **14**, and both housings **60**, **61** are coupled to the cross member **62**. In particular, the first grip leg **55** is partially received by the first housing **60**, and the second grip leg **56** is partially received by the second housing **61**. The first housing **60** is coupled to the first corner **63** of the handle assembly **14** and the second housing **61** is coupled to the second corner **64** of the handle assembly **14**. In other words, the U-shaped grip **46** is partially received within both the first housing **60** and the second housing **61**.

(15) With reference to FIG. **4**A, the legs **54** of the grip **46** are telescopically coupled to the upper arms **32**. Specifically, the first grip leg **55** is received within a hollow portion **58** of the first housing **60**, such that the grip **46** is linearly displaceable (e.g., slidable) along the first longitudinal axis **433** relative to the first upper arm **33**. In a similar manner, the second grip leg **56** is received within a hollow portion of the second housing **61** such that the grip **46** is linearly displaceable along the second longitudinal axis **434** relative to the second upper arm **34**. In particular, a rod **59** extends from the first grip **46** to the first upper arm **33**. In alternate embodiments, the upper arms **32** are received within a hollow portion of the respective grip legs **54** (or vice versa) while the grip **46** remains linearly displaceable relative to the pair of upper arms **32**.

(16) FIGS. **4**A and **4**B illustrate a section of the first housing **60**, the grip **46**, and the cross member **62**. The grip **46** is at least partially received within the first housing **60** and is coupled to the sensor **66**. A biasing member **84** is positioned within the first housing **60** and is biases the grip **46** along the first longitudinal axis **433**. Specifically, the biasing member **84** is positioned between the grip **46** and the handle assembly **14**. In the illustrated embodiment, the biasing member **84** is a linear spring element. In particular, the biasing member **84** acts upon the grip **46** and the upper arms **32**, to urge the grip **46** away from the cross member **62**, toward an extended, first position (FIG. **4**A). Similarly, the grip **46** is movable toward the cross member **62**, against the bias of the biasing member **84** to a compressed, second position (FIG. **4**B).

(17) With reference to FIGS. **3**, **4**A and **4**B, the speed control assembly **30** further includes a sensing device (e.g., a sensor **66**) positioned within the first housing **60**. The sensor **66** is supported, for example, by the cross member **62** adjacent one of the legs **54** of the grip **46**. The sensor **66** detects and/or measures the displacement of the grip **46** relative to the cross member **62** (and the upper arms **32**). In the illustrated embodiment, the sensor **66** is an optical-encoder array. In alternative embodiments, the sensing device **66** is a proximity sensor, a linear potentiometer, a rotary potentiometer, a magnetic transducer, a Hall-effect sensor, a photovalic sensor, a capacitive sensor, a digital position encoder, transducer, or other similar sensor. In further alternative embodiments, the sensor **66** may be an electrical switch that is opened and closed in response to the grip **46** moving to a predetermined location relative to the cross member **62**. Any suitable sensing device for measuring the displacement of the grip **46** relative to the cross member **62** and the main body **18** is considered as part of this invention. For example, the sensing device may detect a force on the grip **46** by a user, as described in greater detail with respect to FIG. **7**.
(18) With reference to FIG. **2**, the sensor **66** is electrically connected to a controller **70** (e.g., a drive system controller, motor controller, etc.) with memory **74** and a processor **78**. Specifically, the sensor **66** generates an electrical output signal (i.e., a control signal) that is received by controller **70**. The output signal from the sensor **66** is based on the position of the speed control assembly **30**. More specifically, the output signal is based on a position of the grip **46** relative to the handle assembly **14**. The memory **74** of the controller **70** stores software setting forth operational parameters for the drive system **22** as determined by the output signal received from the sensor **66**. In particular, the processor **78** of the controller **70** executes the software to control the function of the drive system **22** (e.g., a speed and/or a direction at which the drive system **22** drives the wheels **26**) based on the control output signal from the sensor **66**. In other words, the controller **70** receives the output signal from the sensor **66** and controls a speed of the drive system assembly **22** according to the output signal. In one example, the drive system controller **70** will measure a change in the control signal over time as an input to alter the speed and/or direction at which the drive system **22** drives the wheels **26**. The output signal from the sensor **66** varies with movement of the grip **46** relative to the cross member **62**. In other words, the sensor **66** generates a control output signal (e.g., an analog signal or a digital signal) that is proportional to the magnitude of displacement of the grip **46** relative to the cross member **62**, or other suitable portion of the handle assembly **14**. Alternatively, when the sensing device is an electrical switch, a circuit containing the switch may be open or closed, either activating or deactivating the motor **24**.
(19) The sensor **66** is positioned within the first housing **60**, underneath the biasing member **84**. A first portion **66***a* of the sensor **66** is fixed with respect to the handle assembly **14**, and a second portion **66***b* of the sensor **66** is coupled to the first grip leg **55**. In other words, the second portion **66***b* is affixed within a recess **88** formed within the first grip leg **55** and is movable with the grip **46** as the grip **46** translates along the first longitudinal axis **433**. As such, the second portion **66***b* is movable relative to the first portion **66***a* of the sensor **66**.
(20) With reference to FIG. **4**A, the grip **46** is in a first position. That is, the spring element **84** is uncompressed, and the sensing device **66** is not actuated. In the first position, the tab **66***b* is at one end of the sensing device **66**, and the mower **10** is controlled to have no ground speed. With reference to FIG. **4**B, the grip **46** is in the second position, which corresponds to maximum ground speed operation. That is, the spring element **84** is fully compressed and the sensing device **66** is fully actuated. In the second position, the mower **10** is controlled to have a maximum ground speed, and the tab **66***b* is at a full actuation distance D**1**, indicating maximum compression of the spring element **84**.
(21) In operation, the grip **46** is moved between the extended, first position (FIG. **4**A), in which the control signal does not actuate the drive system **22** to drive the wheels **26**, and the compressed, second position, in which the control signal actuates the drive system **22** to drive the wheels **26**. The speed at which the wheels **26** are driven by the drive system **22** is determined by the

compression of the grip **46** with respect to the handle assembly **14** (e.g., the cross member **62**). In other words, the ground travel speed of the lawn mower **10** is determined by the amount of compression that results from the user's pushing the grip **46** as the user is walking. More specifically, the grip **46** moves between the first position, in which the grip **46** is positioned at a first length L**1** measured from the gripping portion **50** to the cross member **62**. In the illustrated embodiment, the first length L**1** coincides with deactivation of the drive system **22** (i.e., zero ground travel speed). When the grip **46** moves to a second position, the grip **46** is disposed at a second length L**2** measured from the griping portion **50** to the cross member **62**. The sensor **66** detects the displacement of the grip **46** and generates an output control signal that ultimately actuates the drive system **22** to drive the wheels **26** at a speed that matches the user's walking pace. A full actuation distance D**1** is defined as the difference in the first length L**1** and the second length L**2**. Between the first position and the second position, the drive system **22** may drive the wheels **26** at a variable speed that is proportional to the percentage of the actuation distance D**1** that the grip **46** has been displaced. For example, if the grip **46** is moved halfway between the first position and the second position, the drive system **22** drives the wheels **26** at half of the predetermined speed.
(22) In response to the grip **46** moving with respect to handle assembly **14**, the output electrical signal is generated by the tab **66***b* moving with respect to the first portion **66***a* of the sensor **66**. In other words, the sensor **66** measures the displacement of the grip **46** against the spring element **84** in order to gauge the user's desired speed. The output signal from the sensor **66** is received and processed by the drive system controller **70** and the controller **70** drives the motor **24** to drive the wheels **26** at a corresponding speed. An increase of force exerted on the grip **46** by the user results in the grip **46** further compressing the spring **84** and further moving the tab **66***b* with respect to the first portion **66***a*. Such an increase in translation would alter the output signal from the sensor **66** to request an increase of power to the electric motor **24** and a greater speed of the mower **10**.
(23) With reference to FIG. **5**, a speed control assembly **130** in accordance with another embodiment of the invention is coupled to a corresponding handle assembly **114**. The speed control assembly **130** and the handle assembly **114** are similar to the speed control assembly **30** and handle assembly **14** shown in FIGS. **1-3**, and common elements will have the same reference numeral plus “**100**”. As shown in FIG. **5**, the speed control assembly **130** further includes a support member **182**, which extends between the grip **146** and the cross member **162**, and which is movable with the grip **146** relative to the cross member **162**. In this embodiment, the sensing device **166**A may be supported centrally on the cross member **162** for actuation by the support member **182**. In this configuration, the sensing device **166**A may be a “plunger style” sensor that is actuated when the support member **182** is displaced relative to the cross member **162** (i.e., when the grip **146** is displaced upon actuation) along the first longitudinal axis **433** and the second longitudinal axis **434**. Alternatively, as described above and shown in FIG. **3**, the sensing device **166**B may be a “slide style” sensor that is supported at one of the ends of the cross member **162** and that is actuated by relative movement between the grip **146** and the cross member **162** connected to the arms **132**.
(24) FIG. **6** illustrates a speed control assembly **230** in accordance with yet another embodiment of the invention coupled a corresponding handle assembly **214**. The speed control assembly **230** and the handle assembly **214** are similar to the speed control assemblies **30**, **130** and handle assemblies **14**, **114** shown in FIGS. **1-3** or FIG. **5**, and common elements will have the same reference numeral as the embodiment shown in FIGS. **1-3** plus “**200**”. The speed control assembly **230** includes a grip **246** pivotally coupled to the cross member **262** and/or the arms **234** of the handle assembly **214**. The sensing device **266** is actuated by pivoting the grip **246** from the first position (shown with line shading) to the second position (shown without line shading) in a clockwise direction about the first grip pivot axis **455** and the second grip pivot axis **456** from the frame of reference of FIG. **6**. In other words, the sensing device **266** detects the amount of pivotal rotation of the grip **246**. Similar to the speed control assembly **30** described above, the grip **246** is biased towards the first position by a biasing member (e.g., a torsion spring). In further alternative embodiments, the

sensing device **266** is a torque sensor to measure the amount of torque a user places on the grip **246**.

(25) FIG. **7** illustrates a speed control assembly **330** in accordance with a further embodiment of the invention coupled to a corresponding handle assembly **314**. The speed control assembly **330** and the handle assembly **314** are similar to the speed control assemblies **30**, **130**, **230** and handle assemblies **14**, **114**, **214** shown in FIGS. **1-3**, FIG. **5** or FIG. **6**, and common elements will have the same reference numeral as the embodiment shown in FIGS. **1-3** plus "**300**". The speed control assembly **330** includes a grip **346** coupled to the pair of upper arms **332** of the handle assembly **314**. In this embodiment, the grip **346** is only marginally movable relative to the upper arms **332** of the handle assembly **314**. The sensing device **366** is a pressure or force-sensitive device (i.e., a force sensor) that detects a force F applied to the grip **346** by a user in the direction of the handle assembly **314** (e.g., down in FIG. **7**).

(26) Although the invention has been described in detail with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects of the invention as described.

Claims

1. A mower comprising: a handle assembly; a grip coupled to the handle assembly, the grip moveable longitudinally relative to a portion of the handle assembly external to the grip; a sensor operable to generate an output signal based on a position of the grip relative to the portion of the handle assembly external to the grip; and a drive assembly configured to operate based on the output signal.
2. The mower of claim 1, further comprising a controller configured to receive the output signal and control the drive assembly based on the output signal.
3. The mower of claim 1, wherein the sensor is at least one selected from a group consisting of a pressure sensor and a force-sensitive sensor.
4. The mower of claim 1, wherein the grip includes a gripping portion, a first grip leg, and a second grip leg.
5. The mower of claim 4, wherein the first grip leg and the second grip leg are received by the handle assembly.
6. The mower of claim 1, wherein the portion of the handle assembly is parallel to the grip.
7. The mower of claim 1, wherein the output signal varies proportionally to a magnitude of displacement of the grip relative to the portion of the handle assembly.
8. The mower of claim 1, wherein the sensor is a transducer.
9. The mower of claim 1, further comprising a wheel coupled to the drive assembly, wherein the drive assembly drives the wheel.
10. The mower of claim 1, wherein the drive assembly includes an electric motor.
11. The mower of claim 1, wherein a first portion of the sensor is coupled to the grip and moves with the grip as the grip moves relative to the handle assembly; and wherein a second portion of the sensor is fixed with respect to the handle assembly.
12. The mower of claim 1, wherein the grip translates along a longitudinal axis of the handle assembly.
13. The mower of claim 1, further comprising a biasing member positioned between the grip and the handle assembly.
14. The mower of claim 1, further comprising a cutting element rotationally supported on a mower deck.
15. A mower comprising: a handle assembly; a grip partially received within the handle assembly and movable relative to a portion of the handle assembly external to the grip; a sensor configured to generate an output signal based on a position of the grip with respect to the portion of the handle

assembly external to the grip; and a drive assembly configured to operate based on the output signal.
16. The mower of claim 15, wherein the sensor is a force-sensitive sensor operable to measure an amount of force applied to the grip by a user.
17. The mower of claim 15, wherein the handle assembly includes a first upper arm coupled to a first housing and a second upper arm coupled to a second housing, and the grip is partially received within the first housing and the second housing.
18. The mower of claim 17, further comprising a lower arm pivotally coupled to a bracket attached to a deck of the mower and wherein a lower end of at least one selected from a group consisting of the first upper arm and the second upper arm is telescopically received by an upper end of the lower arm.
19. The mower of claim 17, wherein the grip translates along a longitudinal axis defined by at least one selected from a group consisting of the first upper arm and the second upper arm.
20. The mower of claim 15, further comprising a controller configured to receive the output signal and control the drive assembly based on the output signal.