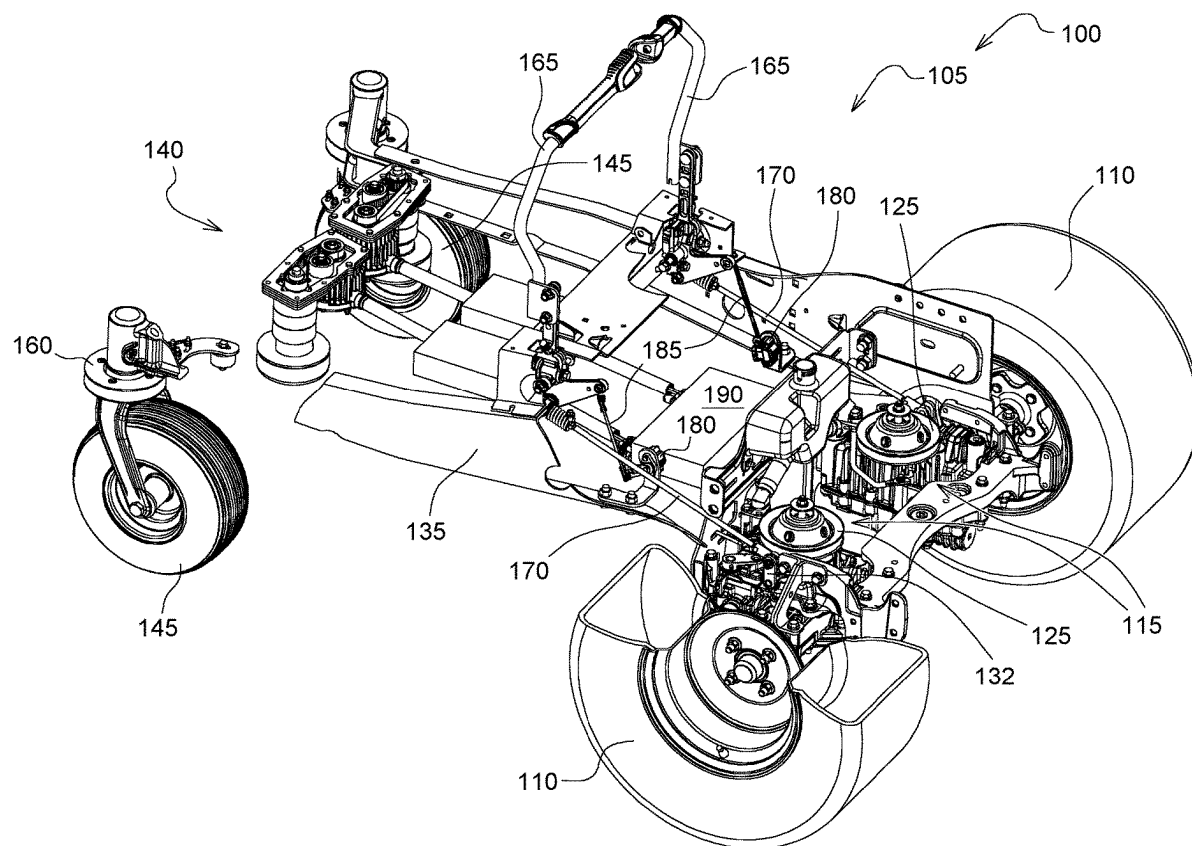


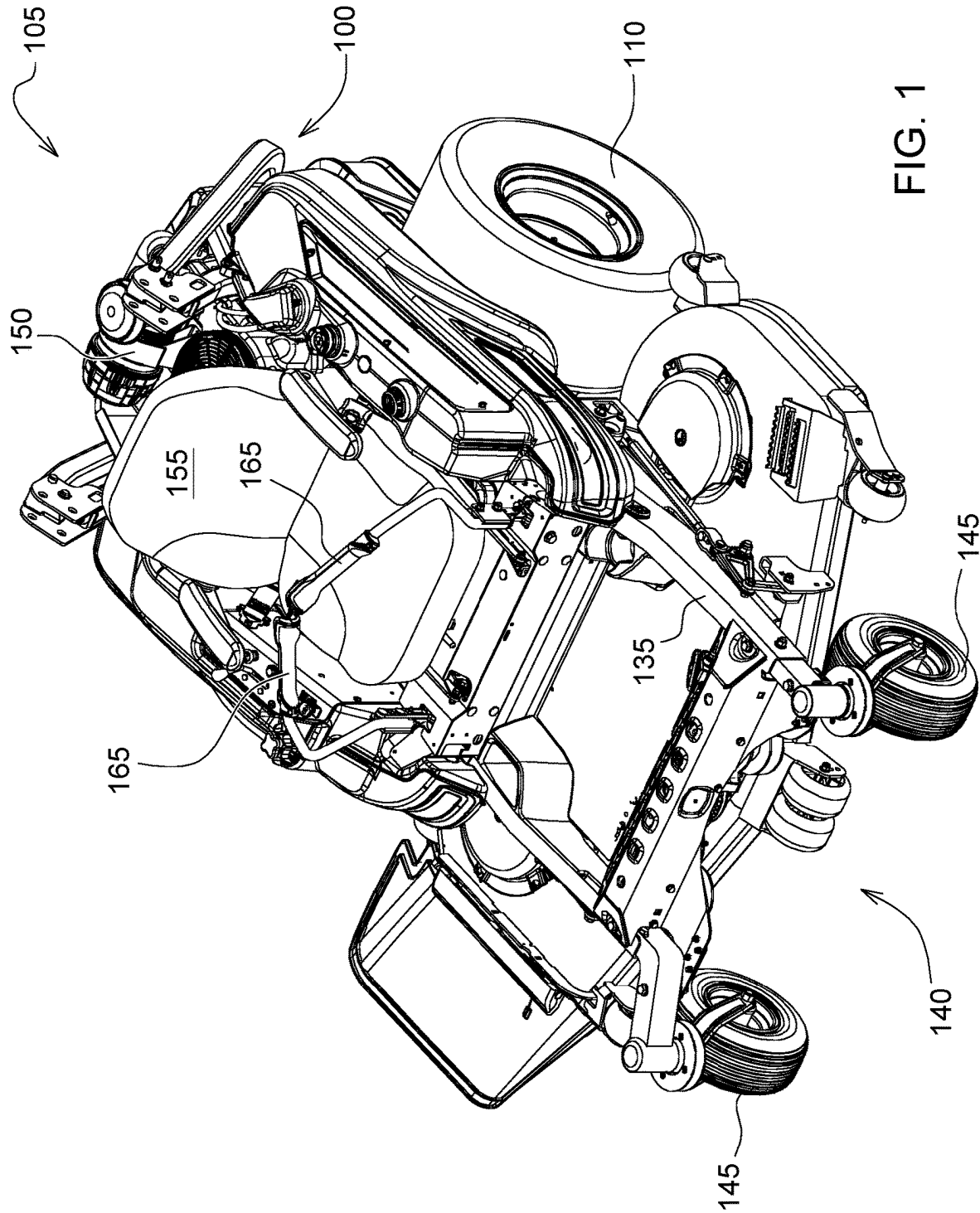


US 20250263122A1

(19) **United States**(12) **Patent Application Publication**
Deshmukh et al.(10) **Pub. No.: US 2025/0263122 A1**(43) **Pub. Date: Aug. 21, 2025**(54) **ZERO TURN MOWER CRUISE CONTROL SYSTEM**(71) Applicant: **Deere & Company**, Moline, IL (US)(72) Inventors: **Vinesh Y. Deshmukh**, Pune (IN);
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Robert D. Dunbar, Holly Springs, NC (US)(21) Appl. No.: **18/581,568**(22) Filed: **Feb. 20, 2024****Publication Classification**(51) **Int. Cl.**
B62D 11/02 (2006.01)
A01D 34/82 (2006.01)
A01D 69/02 (2006.01)
A01D 101/00 (2006.01)
B60K 31/00 (2006.01)(52) **U.S. Cl.**CPC **B62D 11/02** (2013.01); **A01D 34/824**
(2013.01); **A01D 69/025** (2013.01); **B60K**
31/00 (2013.01); **A01D 2101/00** (2013.01)(57) **ABSTRACT**

A ZTR mower cruise control system comprising a pair of motion control levers coupled to drives that rotate rear drive wheels at a velocity. A pair of front wheels that are pivoted to steering angles corresponding to any difference between the positions of the levers. A position sensor positioned to provide a signal based on the position of the levers. A controller configured to receive the signal, receive an operator input corresponding to an activation of a cruise control mode, maintain the steering angles at a current position, receive an updated position of the levers from the position sensor after a change in the position of at least one of the levers, maintain the steering angles at an updated position and receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the steering angles.





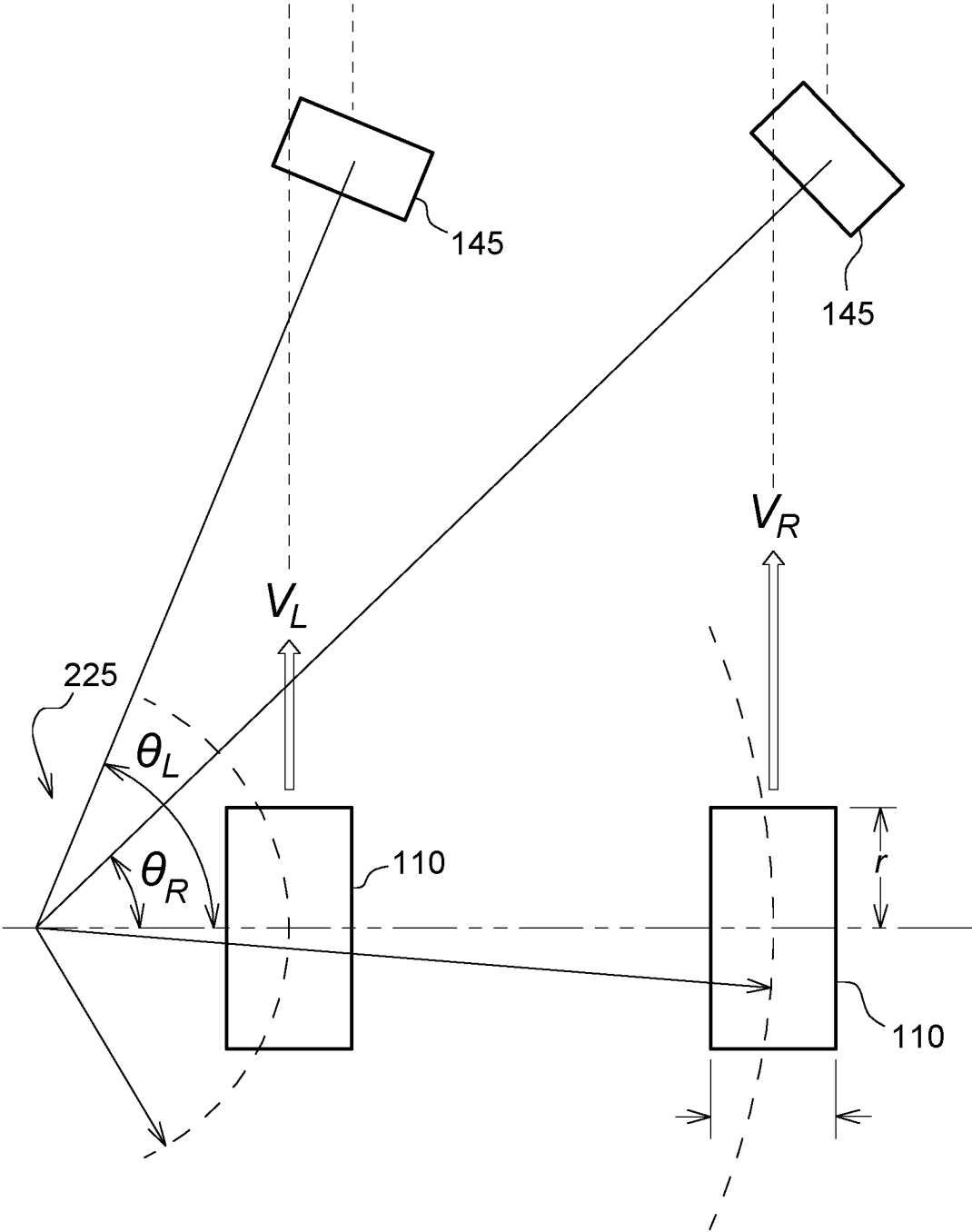
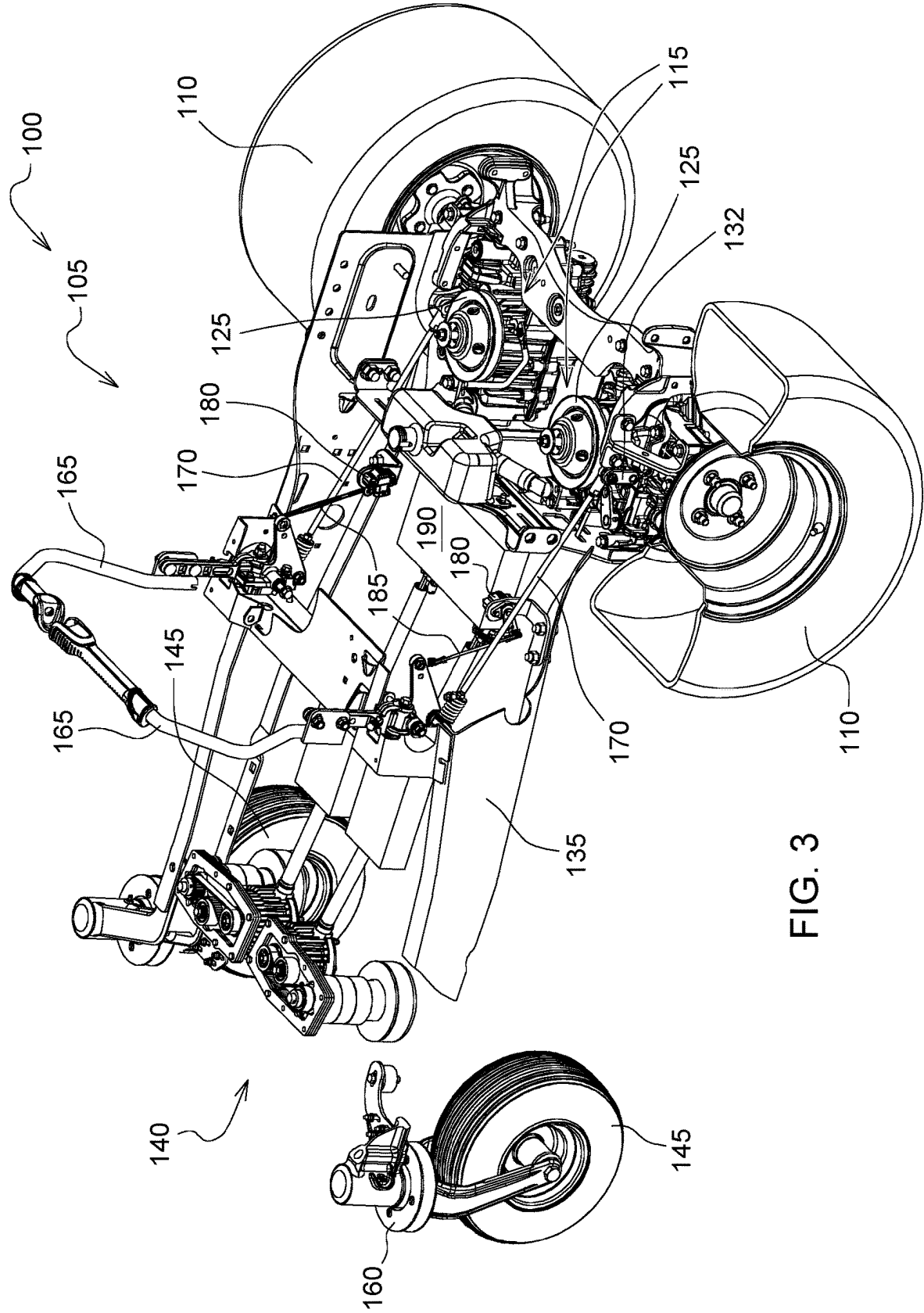
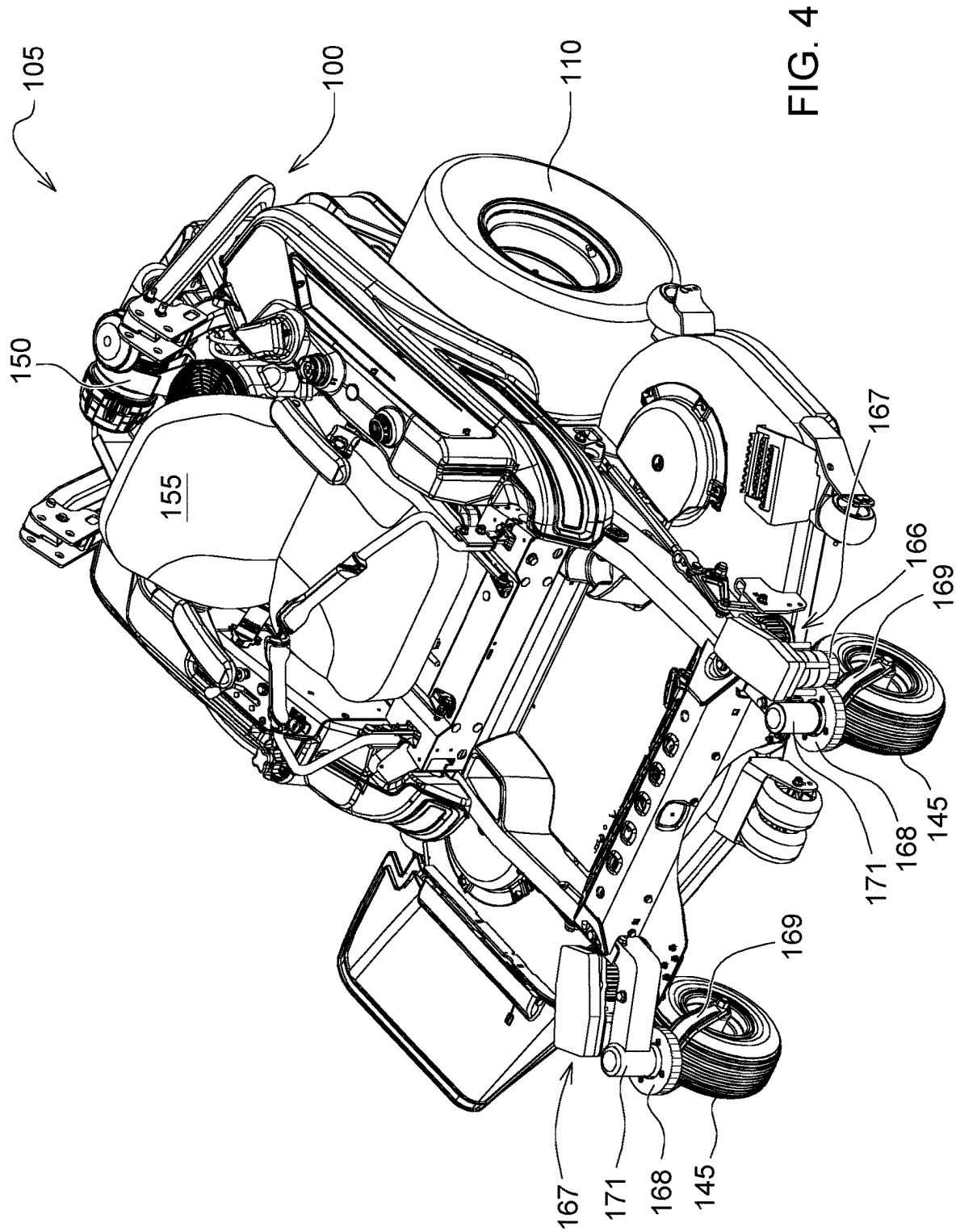


FIG. 2





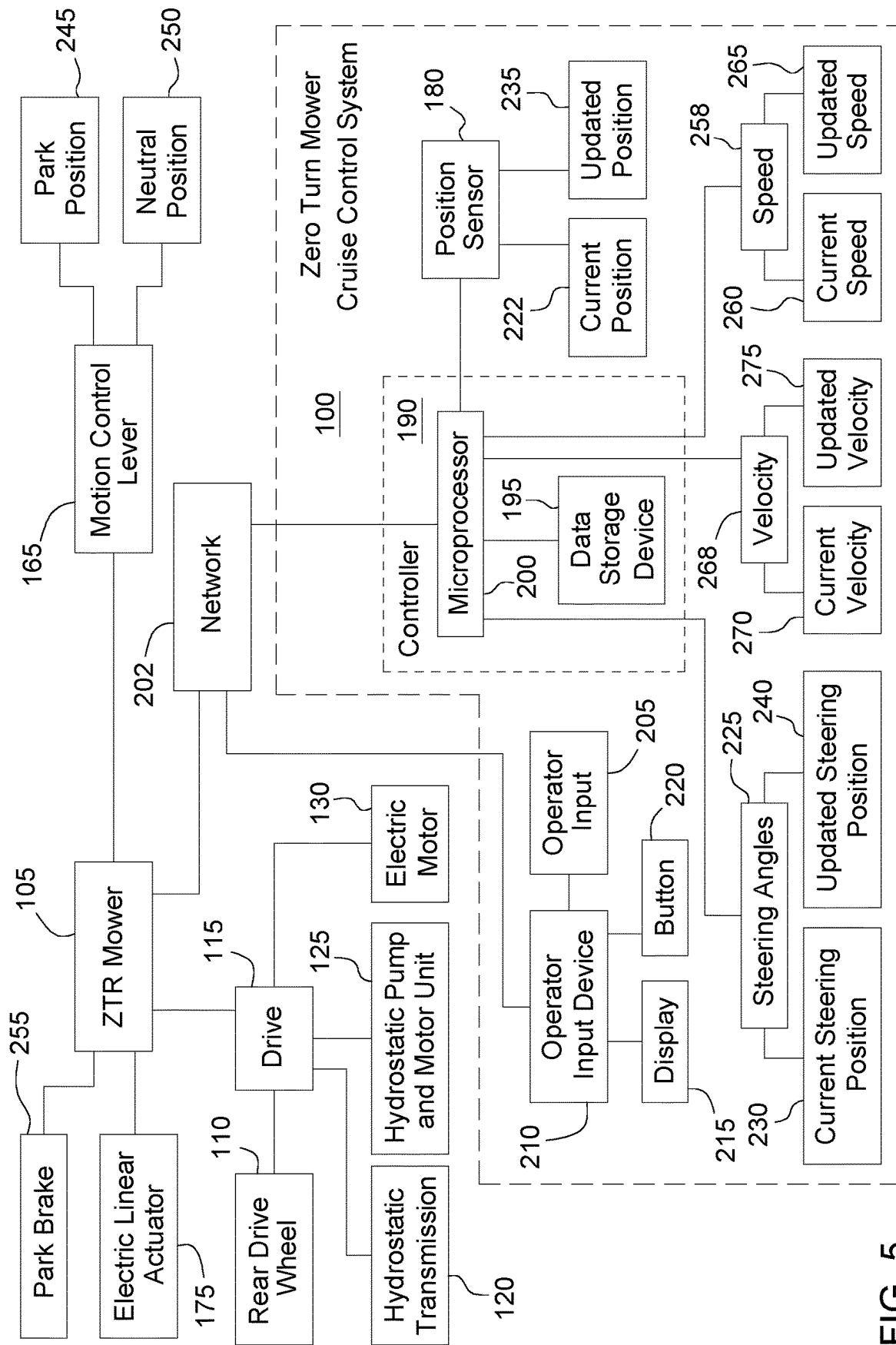


FIG. 5

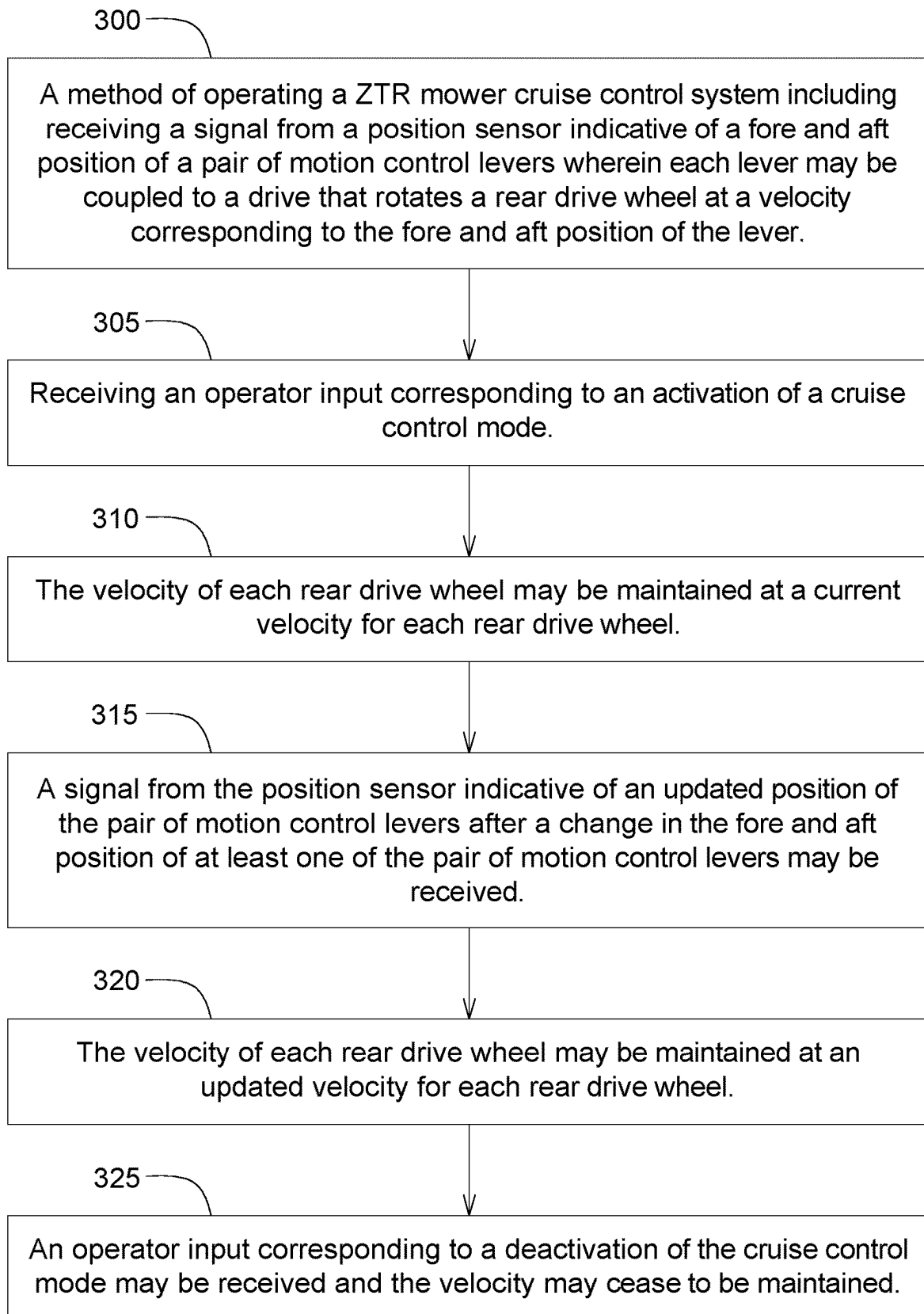


FIG. 6

ZERO TURN MOWER CRUISE CONTROL SYSTEM

FIELD OF THE DISCLOSURE

[0001] This disclosure relates generally to grass mowing machines, and specifically to a zero turn mower cruise control system.

BACKGROUND OF THE DISCLOSURE

[0002] Grass mowing machines known as zero turning radius (“ZTR”) mowers have at least one independently powered rear drive wheel on each side of a frame. Many ZTR mowers have a twin stick control system. A pair of motion control levers or sticks may be provided side-by-side, with each lever or stick controlling one of the rear drive wheels. When both levers or sticks are advanced together forwardly out of their neutral position, both rear drive wheels rotate forwardly to cause the ZTR mower to move forward. A ZTR mower may be steered by advancing one lever or stick more than the other.

[0003] Typically, each motion control lever or stick on a ZTR mower may be linked to a pump arm of one of two separate hydraulic pumps, or of a dual hydraulic pump; i.e., a separate pump for each rear drive wheel. The lever or stick may be used to move a pump swash plate through a direct linkage.

SUMMARY OF THE DISCLOSURE

[0004] A zero turn mower cruise control system for a zero turn mower is disclosed. The zero turn mower comprises a pair of motion control levers, each lever is coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the position of the lever. A pair of front wheels are pivoted to steering angles corresponding to any difference between the positions of the pair of motion control levers. A position sensor is positioned to provide a signal based on the position of the pair of motion control levers. The zero turn mower cruise control system comprises a controller that is configured to receive the signal, receive an operator input corresponding to an activation of a cruise control mode, maintain the steering angles at a current position, receive an updated position of the pair of motion control levers from the position sensor after a change in the position of at least one of the pair of motion control levers, maintain the steering angles at an updated position, and receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the steering angles.

[0005] A zero turn mower cruise control system for a zero turn mower is disclosed. The zero turn mower comprises a pair of motion control levers, each lever is coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the fore and aft position of the lever. A pair of front wheels are pivoted to steering angles corresponding to any difference between the fore and aft positions of the pair of motion control levers. A position sensor is positioned to provide a signal based on the fore and aft position of the pair of motion control levers. The zero turn mower cruise control system comprises a controller that is configured to receive the signal, receive an operator input corresponding to an activation of a cruise control mode, maintain the velocity of each rear drive wheel at a current velocity for each rear drive wheel, receive an updated position of the pair of motion control levers from the position sensor after a change in the

fore and aft position of at least one of the pair of motion control levers, maintain the velocity of each rear drive wheel at an updated velocity for each rear drive wheel, and receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the velocity.

[0006] A method of operating a zero turn mower cruise control system of a zero turn mower is disclosed. The method comprises receiving a signal from a position sensor indicative of a fore and aft position of a pair of motion control levers, each lever coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the fore and aft position of the lever, receiving an operator input corresponding to an activation of a cruise control mode, maintaining the velocity of each rear drive wheel at a current velocity for each rear drive wheel, receiving a signal from the position sensor indicative of an updated position of the pair of motion control levers after a change in the fore and aft position of at least one of the pair of motion control levers, maintaining the velocity of each rear drive wheel at an updated velocity for each rear drive wheel, and receiving an operator input corresponding to a deactivation of the cruise control mode and ceasing to maintain the velocity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a top perspective view of a ZTR mower with a ZTR cruise control system according to one embodiment.

[0008] FIG. 2 is a top view of the geometry used for a ZTR mower steering according to one embodiment.

[0009] FIG. 3 is a rear perspective view of a ZTR mower with a ZTR cruise control system, with some parts removed, according to one embodiment.

[0010] FIG. 4 is a front perspective view of a mechanical linkage of a ZTR mower steering system according to a second embodiment.

[0011] FIG. 5 is a schematic of a ZTR mower with a ZTR mower cruise control system.

[0012] FIG. 6 is a flow chart of a method of operating a zero turn mower cruise control system of a zero turn mower.

DETAILED DESCRIPTION

[0013] FIGS. 1-3 show one embodiment of a ZTR mower cruise control system 100 on a ZTR mower 105 having a pair of rear drive wheels 110 that are independently powered so that each rear drive wheel 110 rotates independently of the other rear drive wheel 110. Each rear drive wheel 110 may be powered by a drive 115 that may be independent from the other drive 115 and may be a hydrostatic transmission 120 (FIG. 5), an integrated hydrostatic pump and motor unit 125, an electric motor 130 (FIG. 5), or other device. Each hydrostatic pump may have a swash plate 132 that may define a pump stroke between a full forward position, a neutral position, and a reverse position.

[0014] The ZTR mower 105 may have a frame 135 supported on a forward portion 140 by front wheels 145, and a rear mounted engine 150 behind operator seat 155. The front wheels 145 may be on casters 160 and spin freely or into a position that results from a velocity of each rear drive wheel 110. The seat 155 may be mounted over the frame 135 for a seated operator to use left and right motion control levers or sticks 165. The front wheels 145 may be pivoted corresponding to any difference between fore and aft positions or other positions of the pair of motion control levers

165. Alternatively, the pair of motion control levers **165** may be a single joystick. The front wheels **145** may be positioned straight and thus not pivoted if the pair of motion control levers **165** are both positioned in the fore and aft positions the same amount. In an alternative embodiment depicted in FIG. 4, the front wheels **145** may be actively controlled via a first gear **166** rotated by an electronic steering actuator **167**, meshing with a second gear **168** mounted to a fork **169** that supports the front wheel **145** to pivot on a vertical spindle **171**.

[0015] The left and right motion control levers **165**, or a single joystick, may be mounted on the ZTR mower **105** and may be pivotable between forward (fore), neutral, and reverse (aft) positions. Each motion control lever **165** may be mounted to the ZTR mower **105** so that each lever **165** may rest in a neutral slot. Each motion control lever **165** may be removed from the neutral slot by moving each motion control lever **165** slightly inwardly towards an operator to clear the neutral slot. Once each motion control lever **165** is out of the neutral slot it is in a neutral band. Once each motion control lever **165** is out of the neutral slot it will stay in the neutral band unless it is moved by the operator. Each motion control lever **165** may be placed back in the neutral slot by moving each motion control lever **165** to the neutral band and then away from the operator. Each motion control lever **165** may pivot forwardly to a forward band to move a swash plate **132** in the hydrostatic pump in a first direction to cause a rear drive wheel **110** to rotate forward or pivot rearwardly to a reverse band to move the swash plate **132** in a second direction to cause the rear drive wheel **110** to rotate backward. Each motion control lever **165** may have a neutral position **250** in which the corresponding rear drive wheel **110** will come to rest. The neutral position **250** is in the neutral band. The pair of motion control levers **165** may be mounted adjacent or in front of the operator's seat **155** on a ZTR mower **105** and may be connected to the hydrostatic pump by a rod **170**. Alternatively, the ZTR mower **105** may include an electric linear actuator **175** that is coupled to a hydrostatic valve that controls the rear drive wheel **110**.

[0016] The ZTR mower cruise control system **100** may include a position sensor **180** for each motion control lever **165** or one position sensor **180** that monitors both levers **165**. The position sensors **180** may be rotary potentiometers that provide signals that vary with the position of a sensor lever. A rod **185** may connect each motion control lever **165** to its respective sensor lever. Each position sensor **180** may provide an electrical signal based on the forward, neutral or reverse position of the motion control lever **165**. The angular velocities (ω_L and ω_R) of each rear drive wheel **110** may be directly proportional to the position of each motion control lever **165**. Therefore, electrical signals indicating the motion control lever **165** positions may correspond to and provide the same result as rear drive wheel **110** angular velocities.

[0017] The ZTR mower cruise control system **100** may include a controller **190** having a data storage device **195** and a microprocessor **200**. The ZTR mower cruise control system **100**, and/or the controller **190**, may communicate with the ZTR mower **105** over a network **202** such as a CAN bus. The data storage device **195** may be configured for storing instructions that are executable by the microprocessor **200** to cause the microprocessor **200** to receive the motion control lever **165** position signals or the rear drive wheel **110** angular velocities. The controller **190** may use the positions of the motion control levers **165**, or the angular

velocities (ω_L and ω_R) of the left and right rear drive wheels **110**, to determine the linear velocities (V_L and V_R) of the left and right rear drive wheels **110**, where r is the tire radius, $V_L = r \omega_L$ and $V_R = r \omega_R$.

[0018] An operator may provide an operator input **205** corresponding to an activation of a ZTR cruise control mode using an operator input device **210** such as a display **215** coupled the ZTR mower **105** or an operator input device **210**, such as a button or switch **220**, coupled to at least one of the motion control levers **165**. The operator input **205** may be received by the controller **190**. The ZTR cruise control mode may include maintaining a direction, a speed, or both a direction and speed of the ZTR mower **105**. Once the ZTR cruise control mode is activated, the operator may release the motion control levers **165** and they will remain in the neutral band.

[0019] For maintaining a direction or steering angles **225**, once the ZTR mower cruise control mode is activated, the controller **190** will receive a current position **222** of the pair of motion control levers **165**, or the angular velocities (ω_L and ω_R) of the left and right rear drive wheels **110**, and maintain the steering angles **225** at a current steering position **230** for both the left front wheel steering angle OL and the right front wheel steering angle OR. This may be done by maintaining the direction, or individual speed, of each rear drive wheel **110**. For example, any change in speed of the ZTR mower **105** would be implemented with a proportionate change in speed of the rear drive wheels **110** in order to maintain the same course of direction of the ZTR mower **105**. In another aspect, the electric linear actuator **175** may be in communication with the controller **190** and when the controller **190** receives an operator input **205** corresponding to an activation of the ZTR cruise control mode, the current hydrostatic valve position may be locked. In yet another aspect, the electronic steering actuator **167** may be in communication with the controller **190** and may be controlled to maintain the direction by maintaining a current setting.

[0020] The controller **190** may receive an updated position **235** of the pair of motion control levers **165** from the position sensor **180** once the pair of motion control levers **165** are removed from the neutral band due to a change in the fore and aft position, or other change in position, of at least one of the pair of motion control levers **165**. The controller **190** may then temporarily maintain the steering angles **225** at an updated steering position **240**, which may add or subtract from the current steering position **230**. Alternatively, the controller **190** may ignore the change in the fore and aft position of at least one of the pair of motion control levers **165** until the pair of motion control levers **165** are first placed in a neutral position **250**. The controller **190** may temporarily maintain the steering angles **225** at the updated steering position **240** unless the operator provides an operator input **205** corresponding to a second activation of a ZTR cruise control mode using an operator input device **210** again to make the updated steering position **240** permanent unless the ZTR cruise control mode is later deactivated. The operator may bring the ZTR mower **105** to a sudden stop by pulling the motion control levers **165** all the way back to the reverse band. This will not disable the ZTR cruise control mode. The operator can also make an end of pass turn without disabling the ZTR cruise control mode.

[0021] The controller **190** may receive an operator input **205** corresponding to a deactivation of the ZTR mower

cruise control system 100 or mode and cease maintaining the steering angles 225. The operator input 205 may include using an operator input device 210 such as the display 215 or the button 220. The operator input 205 may also include shifting the pair of motion control levers 165, or single joystick, to a park position 245 or actuating a park brake 255 that also signals to the controller 190 to deactivate the ZTR mower cruise control system 100 or mode.

[0022] For maintaining a speed, once the ZTR mower cruise control mode is activated, the controller 190 may be configured to maintain a speed 258 of the ZTR mower 105 at a current speed 260. The controller 190 may maintain the current speed 260 by maintaining the speed of the rear drive wheels 110 by controlling the drives 115. The controller 190 may receive an updated position 235 of the pair of motion control levers 165 from the position sensor 180 once the pair of motion control levers 165 are removed from the neutral band due to a change in the fore and aft position, or other change in position, of at least one of the pair of motion control levers 165. The controller 190 may then temporarily maintain the speed 258 at an updated speed 265, which may add or subtract from the current speed 260, by maintaining the speed of the rear drive wheels 110 by controlling the drives 115. Alternatively, the controller 190 may ignore the change in the fore and aft position of at least one of the pair of motion control levers 165 until the pair of motion control levers 165 are first placed in a neutral position 250. The controller 190 may temporarily maintain the speed 258 at the updated speed 265 unless the operator provides an operator input 205 corresponding to a second activation of a ZTR cruise control mode using an operator input device 210 again to make the updated speed 265 permanent unless the ZTR cruise control mode is later deactivated. The operator may bring the ZTR mower 105 to a sudden stop by pulling the motion control levers 165 all the way back to the reverse band. This will not disable the ZTR cruise control mode. The operator can also make an end of pass turn without disabling the ZTR cruise control mode.

[0023] The controller 190 may also receive an operator input 205 corresponding to a deactivation of the ZTR cruise control mode and cease maintaining the speed 258. The display 215 is also configured to receive the operator input 205 to increment or decrement the speed 258.

[0024] In another embodiment, steering angles 225 may be maintained to maintain direction and speed 258 may also be maintained such that velocity 268 is maintained. In this embodiment, each motion control lever 165 may be coupled to a drive 115 that rotates a rear drive wheel 110 at a velocity corresponding to the fore and aft position of the lever 165. A pair of front wheels 145 may be pivoted to steering angles 225 corresponding to any difference between the fore and aft positions of the pair of motion control levers 165. A position sensor 180 may be positioned to provide a signal based on the fore and aft position of the pair of motion control levers 165. A controller 190 may be configured to receive the signal, or the angular velocities (ω_L and ω_R) of the left and right rear drive wheels 110, receive an operator input 205 corresponding to an activation of a cruise control mode, and maintain a velocity 268 of each rear drive wheel 110 at a current velocity 270 for each rear drive wheel 110. The controller 190 may also receive an updated position 235 of the pair of motion control levers 165 from the position sensor 180 once the pair of motion control levers 165 are removed from the neutral band due to a change in the fore

and aft position of at least one of the pair of motion control levers 165 and temporarily maintain the velocity of each rear drive wheel 110 at an updated velocity 275, which may add or subtract from the current velocity 270 unless the operator provides an operator input 205 corresponding to a second activation of a ZTR cruise control mode using an operator input device 210 again to make the updated velocity 275 permanent unless the ZTR cruise control mode is later deactivated. The operator may bring the ZTR mower 105 to a sudden stop by pulling the motion control levers 165 all the way back to the reverse band. This will not disable the ZTR cruise control mode. The operator can also make an end of pass turn without disabling the ZTR cruise control mode. The controller 190 may receive an operator input 205 corresponding to a deactivation of the cruise control mode and cease maintaining the velocity 268.

[0025] Referring to FIG. 6, a method of operating a ZTR mower cruise control system 100 of a ZTR mower 105 is disclosed. In step 300, a signal is received from a position sensor 180 indicative of a fore and aft position of a pair of motion control levers 165 wherein each lever 165 may be coupled to a drive 115 that rotates a rear drive wheel 110 at a velocity corresponding to the fore and aft position of the lever 165.

[0026] In step 305 an operator input 205 corresponding to an activation of a cruise control mode may be received. In step 310, the velocity of each rear drive wheel 110 may be maintained at a current velocity 270 for each rear drive wheel 110.

[0027] In step 315, a signal from the position sensor 180 indicative of an updated position 235 of the pair of motion control levers 165 after a change in the fore and aft position of at least one of the pair of motion control levers 165 may be received. In step 320, the velocity of each rear drive wheel 110 may be maintained at an updated velocity 275 for each rear drive wheel 110. In step 325, an operator input 205 corresponding to a deactivation of the cruise control mode may be received and the velocity may cease to be maintained.

What is claimed is:

1. A zero turn mower comprising:

- a pair of motion control levers, each lever coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the position of the lever;
- a pair of front wheels that are pivoted to steering angles corresponding to any difference between the positions of the pair of motion control levers;
- a position sensor positioned to provide a signal based on the position of the pair of motion control levers; and
- a zero turn mower cruise control system comprising a controller configured to:
 - receive the signal;
 - receive an operator input corresponding to an activation of a cruise control mode;
 - maintain the steering angles at a current position;
 - receive an updated position of the pair of motion control levers from the position sensor after a change in the position of at least one of the pair of motion control levers;
 - maintain the steering angles at an updated position; and
 - receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the steering angles.

2. The zero turn mower of claim 1, wherein the drive is a hydrostatic transmission or an electric motor.

3. The zero turn mower of claim 1, wherein the operator input corresponding to a deactivation of the cruise control mode comprises shifting the pair of motion control levers to a park position, actuating an input device coupled to the pair of motion control levers, or actuating a park brake.

4. The zero turn mower of claim 1, further comprising the controller configured to:

maintain a zero turn mower speed at a current speed by maintaining the speed of the rear drive wheels by controlling the drives;

receive an updated position of the pair of motion control levers from the position sensor after a change in the position of at least one of the pair of motion control levers;

maintain the zero turn mower speed at an updated speed by maintaining the speed of the rear drive wheels by controlling the drives; and

receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the speed.

5. The zero turn mower of claim 4, further comprising an operator interface for receiving the operator input.

6. The zero turn mower of claim 5, wherein the operator interface comprises at least one of a display coupled to the zero turn mower and a button coupled to one or more of the pair of motion control levers.

7. The zero turn mower of claim 6, wherein the display is configured to receive the operator input to increment or decrement the speed.

8. The zero turn mower of claim 1, further comprising an electric linear actuator that is coupled to a hydrostatic valve that controls the rear drive wheel, the electric linear actuator is in communication with the controller and when the controller receives an operator input corresponding to an activation of a cruise control mode, the current hydrostatic valve position is locked.

9. A zero turn mower comprising:

a pair of motion control levers, each lever coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the fore and aft position of the lever;

a pair of front wheels that are pivoted to steering angles corresponding to any difference between the fore and aft positions of the pair of motion control levers;

a position sensor positioned to provide a signal based on the fore and aft position of the pair of motion control levers; and

a zero turn mower cruise control system comprising a controller configured to:

receive the signal;

receive an operator input corresponding to an activation of a cruise control mode;

maintain the velocity of each rear drive wheel at a current velocity for each rear drive wheel;

receive an updated position of the pair of motion control levers from the position sensor after a change in the fore and aft position of at least one of the pair of motion control levers;

maintain the velocity of each rear drive wheel at an updated velocity for each rear drive wheel; and

receive an operator input corresponding to a deactivation of the cruise control mode and cease maintaining the velocity.

10. The zero turn mower of claim 9, wherein the operator input corresponding to a deactivation of the cruise control mode comprises shifting the pair of motion control levers to a park position, actuating an input device coupled to the pair of motion control levers, or actuating a park brake.

11. The zero turn mower of claim 9, further comprising an operator interface for receiving the operator input.

12. The zero turn mower of claim 11, wherein the operator interface comprises at least one of a display coupled to the zero turn mower and a button coupled to one or more of the pair of motion control levers.

13. The zero turn mower of claim 12, wherein the display is configured to receive the operator input to increment or decrement a speed.

14. The zero turn mower of claim 9, further comprising an electric linear actuator that is coupled to a hydrostatic valve that controls the rear drive wheel, the electric linear actuator is in communication with the controller and when the controller receives an operator input corresponding to an activation of a cruise control mode, the current hydrostatic valve position is locked.

15. A method of operating a zero turn mower cruise control system of a zero turn mower, the method comprising:

receiving a signal from a position sensor indicative of a fore and aft position of a pair of motion control levers, each lever coupled to a drive that rotates a rear drive wheel at a velocity corresponding to the fore and aft position of the lever;

receiving an operator input corresponding to an activation of a cruise control mode;

maintaining the velocity of each rear drive wheel at a current velocity for each rear drive wheel;

receiving a signal from the position sensor indicative of an updated position of the pair of motion control levers after a change in the fore and aft position of at least one of the pair of motion control levers;

maintaining the velocity of each rear drive wheel at an updated velocity for each rear drive wheel; and

receiving an operator input corresponding to a deactivation of the cruise control mode and ceasing to maintain the velocity.

16. The method of claim 15, wherein the receiving an operator input corresponding to a deactivation of the cruise control mode comprises shifting the pair of motion control levers to a park position, actuating an input device coupled to the pair of motion control levers, or actuating a park brake.

17. The method of claim 16, wherein the operator input is received via an operator interface, which comprises at least one of a display coupled to the zero turn mower and a button coupled to one or more of the pair of motion control levers.

18. The method of claim 17, further comprising incrementing or decrementing a speed of a rear drive wheel via the display.

19. The method of claim 15, further comprising providing an electric linear actuator that is coupled to a hydrostatic valve that controls the rear drive wheel, the electric linear actuator is in communication with a controller and when the controller receives an operator input corresponding to an activation of a cruise control mode, the current hydrostatic valve position is locked.

20. The method of claim 15, wherein only a direction of the velocity of each rear drive wheel is maintained.