US Patent & Trademark Office
Patent Public Search | Text View

United States Patent Application Publication 20250256791
Kind Code A1
Publication Date August 14, 2025
Inventor(s) Borkholder; Carl J.

Dynamically Adjustable Gooseneck Ball Mount

Abstract

A dynamically adjustable gooseneck mount has a linear actuator that is removably affixed to a towing vehicle over the vehicle's rear axle. A gooseneck ball is affixed to a movable portion of the actuator and can move between a forward position and a rearward position through operation of a motor. The mount includes a sensor that can sense a flag that is attached to the coupler on a trailer. When the sensor detects the flag, the motor moves the gooseneck ball forward. If the towing vehicle and trailer are at a sufficient angle with respect to each other, the sensor no longer detects the flag and moves the gooseneck ball rearward. In the forward position, the gooseneck ball is forward of the axle and in the rearward position, the gooseneck ball is behind the axle.

Inventors: **Borkholder; Carl J. (Nappanee, IN)**

Applicant: **Gen-Y Creations, LLC** (Nappanee, IN)

Family ID: **96661568**

Assignee: **Gen-Y Creations, LLC (Nappanee, IN)**

Appl. No.: **18/438682**

Filed: **February 12, 2024**

Publication Classification

Int. Cl.: **B62D53/08** (20060101)

U.S. Cl.:

CPC **B62D53/0814** (20130101);

Background/Summary

BACKGROUND OF THE INVENTION

[0001] The present disclosure relates to devices that attach a trailer to a towing vehicle. 5.sup.th wheel and gooseneck trailers have towing setup requirements, such as locating the tongue weight of the trailer over the towing vehicle's axle. For short bed trucks, locating the tongue weight directly over the axle places the front of some trailers (such as recreational vehicles) close enough to the cab that turning too tightly causes the front of the trailer to contact the cab, damaging both the trailer and truck. Other devices have attempted to solve this problem by positioning the trailer connection point rearward of the axle. By positioning the trailer rearward, the problem created by turning is solved, but the rearward bias of the tongue load makes the entire towing dynamic of truck and trailer less stable. Further, the increased distance between the truck cab and nose of the trailer increases wind resistance and lowers fuel economy.

[0002] Since tight turning is only performed when parking or moving at slow speeds, the trailer connection point only needs to be biased rearward periodically. Others have attempted to solve this problem, such as the sliding 5.sup.th wheel hitches in U.S. Pat. Nos. 7,753,392 and 9,511,804. This device only works with 5.sup.th wheel and pin box connections and requires a part to be affixed to the trailer to engage with the entry slot of the 5.sup.th wheel hitch plate and prevent the trailer from rotating with respect to the 5.sup.th wheel. Instead, the mechanism is forced to rotate the 5.sup.th wheel when the truck turns with respect to the trailer. This causes a mechanism to rotate and slide rearward through a large rack and pinion gear engagement or cam following a slot. This setup is not applicable to a gooseneck trailer, as there is no simple way to keep the trailer from rotating with respect to the connection point. Further, binding of the mechanical components can create unexpected torsional stress in the pin box or accidents from unduly restricted movement between truck and trailer. Other known issues with this setup includes wear or slop in the mechanism that causes undesirable chucking or banging between the truck and trailer. An improved device is needed.

SUMMARY OF THE INVENTION

[0003] The present disclosure describes an assembly for attaching a trailer to a towing vehicle having an axle. The assembly comprises a base frame configured to be removably affixed to said towing vehicle with the base frame partially overlaying the vehicle's rear axle. A linear actuator has a stationary portion affixed to the base frame and a movable portion affixed to a gooseneck ball. The movable portion is longitudinally moveable between a fore position and an aft position. The assembly has a controller in electrical communication with a sensor and the linear actuator. The trailer has a coupler that mates to the gooseneck ball and has a sensor flag. When the trailer coupler and vehicle are aligned, the sensor detects the sensor flag. When the sensor detects a first angle between the trailer and towing vehicle, the linear actuator moves the gooseneck ball to a first position. When the sensor detects a second angle between the trailer and towing vehicle, the linear actuator moves the gooseneck ball to a second position.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. **1** is a side view of a trailer coupled to a towing vehicle;

[0005] FIG. **2** is a top isometric view of the towing vehicle and coupler in FIG. **1**;

[0006] FIG. **3** is a front isometric view of the coupler and front portion of the trailer in FIG. **1**;

[0007] FIG. **4** is a rear isometric view of the coupler;

[0008] FIG. **5** is a bottom isometric view of the coupler;

[0009] FIG. **6** is a side section view **6**-**6** of the coupler in FIG. **4** in the fore position;

[0010] FIG. **7** is a side section view **6**-**6** of the coupler in FIG. **4** in the aft position;

[0011] FIG. **8** is a top isometric view of the coupler in the aft position;

[0012] FIG. **9** is a top view of the towing vehicle and trailer in alignment and coupler in the fore position, along with the trailer at an angle and coupler in the aft position, shown in broken lines;
[0013] FIG. **10**A is a graphical representation of the travel of the actuator versus the angle of the trailer using a digital sensor;
[0014] FIG. **10**B is a graphical representation of the travel of the actuator versus the angle of the trailer using an angle sensor and programmable setpoints; and
[0015] FIG. **11** is an isometric section view **11-11** of the fastener portion of the coupler in FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] A trailer coupler **10** is shown in FIG. **1** that attaches to the bed of a towing vehicle **12**. The towing vehicle **12** has a bed **14** with a floor **16** and a cab **18** that is forward of the bed **14**. The bed **14** is located over an axle **20** and may consist of a flat surface, frame rails, or other type of mounting platform that allows secure attachment to the vehicle's structure. The mounting platform or bed **14** may include a puck system that has a gooseneck pocket **22** and at least one additional anchor point **24**. In the embodiment shown in FIG. **2**, the towing vehicle **12** has four anchor points **24** that are spaced from the gooseneck pocket **22**. The gooseneck pocket **22** is laterally (side to side) centered over the axle **20** but may be longitudinally (fore or aft) offset from the axle **20**. For the purposes of this disclosure, longitudinal movement or position is in the direction of travel of the towing vehicle. The gooseneck pocket **22** and anchor points **24** are rigidly affixed to the vehicle's frame and accessed at or through the floor **16** of the bed **14**. The trailer coupler **10** is designed to mate with a trailer **30**, shown in FIG. **3**. It is contemplated that the towing vehicle **12** uses an alternative device or method for attaching, such as a bed rail system (not shown). Bed rail systems typically consist of two parallel rails mounted over the rear axle in a direction perpendicular to the direction of travel.
[0017] As shown, the trailer **30** has a gooseneck coupler **32** that provides a secure connection to a gooseneck ball **46**. The gooseneck coupler **32** has a lead-in flange **34** that leads to a ball pocket. When the gooseneck coupler **32** is latched, the spherical portion of the gooseneck ball is trapped while still allowing rotation of the gooseneck ball **46** with respect to the gooseneck coupler **32**. In other words, the gooseneck coupler **32** does not impart rotational movement to the gooseneck ball **46**. The trailer **30** has a front surface **36** that faces the rear surface **26** of the cab **18**, shown in FIG. **1**. The distance D between the front surface **36** of the trailer **30** and rear surface **26** of the cab **18** varies based on the individual towing vehicle **12** and trailer **30**.
[0018] The trailer coupler **10** has a base frame **40** that has a linear actuator **42**, a sensor **44**, and components for affixing the trailer coupler **10** to the towing vehicle **12**. The linear actuator **42** is an assembly of components that cooperate to support and move the gooseneck ball **46** longitudinally between a fore position (shown in FIG. **6**) and an aft position (shown in FIG. **7**). Throughout the travel of the linear actuator **42**, the gooseneck ball **46** does not rotate and only moves in a longitudinal direction with respect to the towing vehicle **12**. The linear actuator **42** is a structural component that carries the load applied to the gooseneck ball **46** and transfers it to the towing vehicle **12**. The linear actuator **42** can move to any position between the fore and aft positions while carrying the load of the trailer. The gooseneck ball **46** has a gooseneck axis **45** that extends vertically as shown in FIG. **6**. The linear actuator **42** has a top plate **48** with an elongate slot **50**. The elongate slot **50** has a fore end **51** and an aft end **53** located opposite from the fore end **51**. Parallel to the top plate **48** and spaced therefrom is a bottom plate **52**. Along with the plates **48**, **52**, sides **54**, **56** and end walls **58**, **60** form the outer structure of the linear actuator **42** that form a partially enclosed volume. Located in the partially enclosed volume and sandwiched between the top and bottom plates **48**, **52** is a sliding block **62**. The sliding block **62** is a flat structural component, an upper surface **63** and lower surface **65**. The gooseneck ball **46** is affixed to the sliding block **62** and extends through the elongate slot **50** to form a movable portion of the linear actuator. The sliding block **62** is supported by an upper bearing block **64** and a lower bearing block **66** that reduce friction when the sliding block **62** moves between the fore and aft positions. The

bearing blocks **64**, **66** can be a solid block of material with improved wear properties, a bearing assembly with moving parts, or equivalent. The length and width of the sliding block **62** transfers forces on the gooseneck ball **46** to the outer structure of the linear actuator **42**. In other words, the linear actuator **42** transfers forces to the vehicle **12** that come from the gooseneck ball **46**. A captured nut **68** is affixed or otherwise captured to the sliding block **62** so that movement of the captured nut **68** also moves the sliding block **62**. As shown in section view FIG. **6**, a screw shaft **70** is held within the linear actuator **42** and mated to the captured nut **68** so that when the screw shaft **70** rotates, the captured nut **68** creates fore or aft movement of the gooseneck ball **46**. As shown, the screw shaft **70** is an Acme lead screw, but other screw types are contemplated. The screw shaft **70** protrudes through the end wall **58** where it is coupled to a motor **80**. The motor **80** has an output shaft **82** that connects to a terminal end **72** of the screw shaft **70**. The linear actuator **42** or motor **80** may include a position sensor (not shown) to communicate the position of the captured nut **68**, gooseneck ball **46**, or other movable components in the trailer coupler **10**.

[0019] The sensor **44** is shown affixed to the motor **80**, but other mounting options are contemplated. In the embodiment disclosed herein, the sensor **44** uses optical sensing technology to measure the presence or absence of a reflective flag **90**. The flag **90** is affixed to the gooseneck coupler **32** that is affixed to the trailer **30**. In the embodiment shown herein, the flag **90** has a width that translates to roughly **50** degrees of angular rotation of the trailer **30** in either direction before the flag **90** moves out of view of the sensor **44**. When the towing vehicle **12** and trailer **30** are aligned (such as when traveling down a straight road), the sensor **44** detects the reflective flag **90**. This is shown in FIG. **9** in solid lines. If the towing vehicle **12** and trailer **30** are at a large enough angle with respect to each other (such as when going around a corner or backing into a parking spot), the sensor **44** does not detect the reflective flag **90**. In other words, if the sensor **44** doesn't detect the flag **90**, the angle is above a predetermined limit. This is shown in FIG. **9** with the trailer **30′** in broken lines. In the embodiment shown herein, the flag **90** is a band of material that is detected by the sensor **44** when located within the sensor's sensing range. If the flag **90** is outside of the sensing range, the sensor **44** provides a signal that it does not detect the flag **90**. It is also contemplated that instead of a presence/absence detection of the reflective flag **90**, the sensor **44** measures the angle between the towing vehicle **12** and trailer **30**. In this case, the predetermined limit may be determined by a settings in the controller. Other non-contacting or contacting sensing technologies are contemplated, such as magnetic, proximity, photographic, resistive, pressure, or angle. It is further contemplated that the sensor **44** provides a distance measurement for the fore/aft position of the actuator by measuring the distance of the flag **90** or the flag **90** is a fiducial marker.

[0020] A controller **92** receives power through a power cord **94** and is in electrical communication with the sensor **44** and motor **80**. If equipped, the position sensor for the linear actuator **42** is also in electrical communication with the controller **92**. The controller **92** monitors the signal from the sensor **44** to determine the position of the trailer **30** relative to the towing vehicle **12**. As shown in FIG. **9**, the gooseneck ball **46** is moved forward when the trailer **30** and towing vehicle **12** are aligned. When the sensor **44** signals a sufficient angle between the towing vehicle **12** and trailer **30′**, the controller **92** enables the motor **80** to move the gooseneck ball **46** towards the aft position, shown as **46′** in broken lines in FIG. **9**. The relationship of the trailer angle and longitudinal position of the gooseneck ball is graphically represented in FIGS. **10**A and **10**B. FIG. **10**A is a graph showing the position of the gooseneck ball **46** based on the angle of the trailer using a sensor **44** with a digital (on/off) output. When the angle is low and the sensor **44** can see the flag **90**, the gooseneck ball **46** is in the fore position. In the embodiment shown herein, the fore position is forward of the gooseneck pocket **22** and stem axis **105**, represented by the Y axis. The transition **96** between fore and aft in FIG. **10**A occurs when the angle of the trailer causes the sensor **44** to no longer see the flag **90**. When the sensor **44** detects that the towing vehicle **12** and trailer **30** are returning to alignment, the controller **92** enables the motor **80** to move the linear actuator **42** towards the fore position. For other embodiments using a sensor **44** that measures the angle of the

trailer **30** (either directly or indirectly), it is possible for the user to program setpoints **98**, slope, and positions for the linear actuator **42** for the predetermined limits, such as shown in FIG. **10**B.
[0021] An optional handheld control (not shown) is in communication with the controller **92** and may be in the form of a wireless or wired remote control, mobile device application, or other method to move the linear actuator **42**, read information and status of the sensor **44**, read the position of the linear actuator **42**, assist the user with troubleshooting, or add position presets for the fore/aft position of the gooseneck ball **46**. The power cord **94** receives power from an existing vehicle wiring harness or trailer connection.
[0022] The base frame **40** includes a fore mounting portion **100**, an aft mounting portion **102**, and a stem **104**. The fore and aft mounting portions **100**, **102** and stem **104** are affixed to the linear actuator **42**. The mounting portions **100**, **102** have rotatable fasteners **106** to mate with the anchor points **24**. Each fastener **106** has a rotatable shaft **108** that is fixed with respect to a locking handle **110**, such that rotating the locking handle **110** also rotates the rotatable shaft **108**. At the end of each rotatable shaft is a key feature that rotates with the shaft **108** and locks to the anchor points **24** when received by them and the locking handle **110** is then rotated to the locked position. A fixed handle **114** is adjacent the locking handle **110**. When the locking handle **110** is rotated to a locked position, shown in FIG. **11**, the locking handle **110** and fixed handle **114** are in alignment such that locking apertures **112**, **116** in the handles are in alignment to receive a lock, pin, or other device to prevent the locking handle **110** from being rotated away from the locked position. The rotatable fasteners **106** also include an alignment bushing **118** that centers the rotatable shaft **108** and provides the proper alignment for engagement with locking features in the anchor points **24**.
[0023] The stem **104** has a stem axis **105** and mates with the gooseneck pocket **22** and has a major diameter **120** and a minor diameter **122**. As installed on the towing vehicle **12**, the minor diameter **122** is located inside the gooseneck pocket **22** and the step **124** where the major diameter **120** begins and is supported by the gooseneck pocket **22**. As shown, the stem **104** is affixed in an aperture **126** in the bottom plate **52** of the linear actuator **42**. As the linear actuator **42** moves between the fore and aft positions, the gooseneck axis **45** crosses the stem axis **105**. It is also contemplated that the linear actuator **42** is affixed to or integrated with the trailer **30** or gooseneck coupler **32**. In the embodiment shown herein, the stem **104** is only located in the gooseneck pocket **22** and not affixed thereto. The coupler **10** is affixed to the vehicle using the rotatable fasteners **106**.
[0024] As previously described, the gooseneck coupler **32** attaches or is affixed to the frame of the trailer **30**. As shown in FIG. **3**, the gooseneck coupler **32** mates to the gooseneck ball **46** to connect the trailer **30** to the towing vehicle **12**. The gooseneck coupler **32** is moveable between a locked position and an unlocked position. In the locked position, the gooseneck ball **46** is trapped within a gooseneck ball cavity **38**. In the unlocked position, the gooseneck ball **46** can enter or exit the gooseneck ball cavity **38** for mating and un-mating with the gooseneck ball **46**.
[0025] To install the trailer coupler **10** on the towing vehicle **12**, the user first rotates the rotatable fasteners **106** to the unlocked position and removes any dust covers from the gooseneck pocket **22** and anchor points **24** on the towing vehicle **12**. The user then aligns the stem **104** to the gooseneck pocket **22** and lowers the coupler **10** to mate the rotatable fasteners **106** with the anchor points **24**. The user then rotates the rotatable fasteners **106** to the locked position and adds any locks or pins as needed or required. The user then connects the power cord **94** to the vehicle **12**. Once power is applied to the coupler **10**, the user can then jog the actuator **42** to move the gooseneck ball **46** to the desired starting position. If the trailer **30** is not mated to the gooseneck ball **46** or if the flag **90** is not affixed to the gooseneck coupler **32**, the controller **92** may move the gooseneck ball **46** to the aft position. Once the trailer **30** is coupled to the gooseneck ball **46** and the flag **90** is detected by the sensor **44**, the controller moves the gooseneck ball **46** to the fore position. During normal towing (where the towing vehicle **12** and trailer **30** are aligned), the controller **92** maintains the gooseneck ball **46** in the fore position. The fore position is either determined by a preset that the user has set, or it is fully forward where the linear actuator **42** has reached a mechanical limit. If the

towing vehicle **12** and trailer **30** are moved out of alignment (such as when backing into a parking space or navigating a tight turn), the flag **90** rotates out of view of the sensor **44** and the controller **92** moves the gooseneck ball **46** to the aft position. The aft position is either determined by a preset that the user has set or it is fully rearward where the actuator **42** has reached a mechanical limit, such as the gooseneck ball contacting the aft end **53** of the elongate slot **50**.

[0026] It is understood that while certain aspects of the disclosed subject matter have been shown and described, the disclosed subject matter is not limited thereto and encompasses various other embodiments and aspects. No specific limitation with respect to the specific embodiments disclosed herein is intended or should be inferred. Modifications may be made to the disclosed subject matter as set forth in the following claims.

Claims

1. An assembly for attaching a trailer to a towing vehicle, said towing vehicle having an axle, said assembly comprising: a base frame configured to be removably affixed to said towing vehicle with said base frame partially overlaying said axle; a linear actuator having a stationary portion affixed to said base frame and a movable portion affixed to a gooseneck ball, said movable portion longitudinally moveable between a fore position and an aft position; a controller in electrical communication with a sensor and said linear actuator; when said sensor detects a first angle between said trailer and said towing vehicle, said linear actuator moves said gooseneck ball to a first position, when said sensor detects a second angle between said trailer and said towing vehicle, said linear actuator moves said gooseneck ball to a second position.

2. The assembly of claim 1, further comprising a stem affixed to said base frame, said stem having a stem axis, said gooseneck ball having a gooseneck axis, said base frame having at least one fastener rotatable between a locked position and an unlocked position, said first position defined by said gooseneck axis being forward of said stem axis, said second position defined by said gooseneck axis being rearward of said stem axis.

3. The assembly of claim 2, wherein said towing vehicle has a gooseneck pocket and at least two anchor points offset from said gooseneck pocket, said gooseneck pocket for receiving said stem, said anchor points for receiving said fasteners, when said anchor points receive said fasteners and said gooseneck pocket receives said stem, said base frame is affixed to said towing vehicle.

4. The assembly of claim 1, when said assembly is affixed to said towing vehicle, said first position is defined by said gooseneck ball being forward of said axle, said second position is defined by said gooseneck ball being rearward of said axle.

5. The assembly of claim 1, wherein said towing vehicle having parallel rails affixed thereto, said base frame affixable to said parallel rails.

6. The assembly of claim 1, further comprising a coupler for being affixed to said trailer, said coupler is mateable to said gooseneck ball.

7. The assembly of claim 6, further comprising a flag being fixed with respect to said coupler, said first angle is defined by said flag in view of said sensor.

8. The assembly of claim 6, wherein said sensor is fixed with respect to said base frame, a flag is affixed to said coupler.

9. The assembly of claim 1, wherein all forces applied to said gooseneck ball transfer to said vehicle through said linear actuator.

10. The assembly of claim 1, wherein said linear actuator has a bottom plate and a top plate, said top plate is spaced from and parallel to said bottom plate, said top plate having an elongate slot, said movable portion comprising a sliding block constrained between said top and bottom plates, said gooseneck ball is affixed to said sliding block and extending through said elongate slot in said top plate, said fore position is defined by said gooseneck ball located adjacent one end of said elongate slot, said aft position defined by said gooseneck ball located adjacent another end of said

elongate slot opposite said fore position.

11. A dynamically adjustable connection for coupling a trailer to a towing vehicle having an axle, said connection comprising: a linear actuator having a bottom plate and a top plate, said top plate having an elongate slot, a sliding block constrained between said top and bottom plates, a gooseneck ball affixed to said sliding block and extending through said elongate slot in said top plate, said gooseneck ball and said sliding block movable between an aft position and a fore position, said gooseneck ball having a gooseneck axis; a stem having a stem axis affixed to said bottom plate, said stem for being received by a gooseneck pocket on said towing vehicle, said linear actuator having at least one fastener rotatable between a locked position and an unlocked position; a motor coupled to said sliding block and in electrical communication with a controller; a sensor in electrical communication with said controller; when trailer is coupled to said gooseneck ball, said sensor detects an angle between said towing vehicle and said trailer, when said angle is over a predetermined limit, said motor moving said gooseneck ball towards said aft position, when said angle is below said predetermined limit, said motor moving said gooseneck ball towards said fore position; and said gooseneck axis is coaxial with said stem axis at a point between said fore and aft positions, said fore position defined by said gooseneck axis being forward of said stem axis, said aft position defined by said gooseneck axis being rearward of said stem axis.

12. The connection of claim 11, wherein said towing vehicle has at least two anchor points offset from said gooseneck pocket, when said anchor points receive said fasteners and said gooseneck pocket receives said stem, said linear actuator is affixed to said towing vehicle.

13. The connection of claim 11, when said connection is affixed to said towing vehicle, said fore position is defined by said gooseneck ball being forward of said axle, said aft position is defined by said gooseneck ball being rearward of said axle.

14. The connection of claim 11, wherein said gooseneck ball is fixed from rotation with respect to said linear actuator.

15. The connection of claim 11, further comprising a coupler for being affixed to said trailer, said coupler is mateable to said gooseneck ball.

16. The connection of claim 15, further comprising a flag being fixed with respect to said coupler, said sensor is fixed with respect to said linear actuator.

17. A method of towing a trailer comprising: providing a towing vehicle having an axle and a mounting platform located above said axle; affixing a linear actuator to said mounting platform, said linear actuator having a gooseneck ball extending vertically therefrom and longitudinally moveable between a fore position and an aft position, said fore position defined by said gooseneck ball located forward of said axle, said aft position defined by said gooseneck ball located rearward of said axle; providing a sensor in communication with a controller, said controller in communication with said linear actuator; providing a trailer coupler affixed to said trailer; coupling said trailer coupler to said gooseneck ball; said sensor detecting an angle between said trailer and said towing vehicle; and said controller moving said gooseneck ball toward said aft position when said angle between said trailer and said towing vehicle is over a predetermined limit, said controller moving said gooseneck ball toward said fore position when said angle between said trailer and said towing vehicle is below said predetermined limit.

18. The method of claim 17, further providing a flag affixed to said trailer coupler, said sensor and said flag cooperating to detect said angle between said trailer and said towing vehicle.

19. The method of claim 17, further providing a gooseneck receiver on said mounting platform, providing a stem having a stem axis on said linear actuator, locating said stem in said gooseneck receiver, said gooseneck ball having a gooseneck axis parallel to said stem axis, said gooseneck axis is coaxial with said stem axis at a point between said fore and aft positions, said fore position defined by said gooseneck axis being forward of said stem axis, said aft position defined by said gooseneck axis being rearward of said stem axis.

20. The method of claim 17, further providing a pair of parallel rails affixed to said mounting platform, said linear actuator affixed to said pair of rails.