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(54) Title: A DEVICE FOR CORRECTING DEVIATION IN THRUST ANGLE OF AN AXLE OF A MULTI AXLE VEHICLE

(57) Abstract: A device (100) for correcting deviation in thrust angle of an axle (210) of a multi axle vehicle (200) is disclosed. The device (100) includes a platform (10) with a support member (12) extending upwardly to support a cylinder assembly (20). The cylinder assembly (20) is positioned perpendicularly between at least two axles (210) of the vehicle. The cylinder assembly (20) comprises a cylinder (22) with a chamber (24) having a pair of pistons (25) movable between an extended position and a retracted position via a piston rod projecting outwardly. A hydraulic fluid and a compressed air sources are fluidly connected to cylinder (22) for supplying pressurized hydraulic fluid to act on one side of the pair of pistons (25) to actuate from retracted position to extended position to correct the thrust angle. The compressed air is supplied to act on other side (25b) opposite to the one side (25a) of each of the pair of pistons (25) to actuate from the extended position to the retracted position.

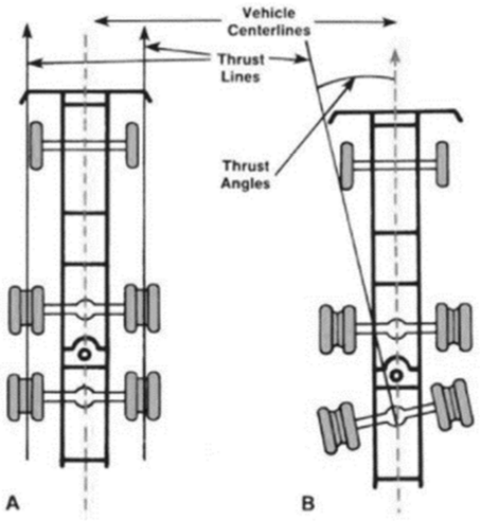

Figure 1 (prior art)

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A DEVICE FOR CORRECTING DEVIATION IN THRUST ANGLE OF AN AXLE OF A MULTI AXLE VEHICLE

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification describes the invention and the manner in which it is to be performed

DESCRIPTION

Technical Field

[001] This disclosure relates generally to vehicles, and more particularly to a device for correcting deviation in a thrust angle of an axle of multi axle vehicles.

BACKGROUND

[002] In general, heavy-duty vehicles like buses, tractor trailers, and trucks etc., have multiple axles. Usually, these vehicles include multiple axles at a rear of the vehicle, also referred as rear axles, and in some vehicles such multiple axles can be provided in the front end. In case of multiple axles at the rear end, the multiple rear axles are configured parallel to a front axle of the vehicle. Traditionally, thrust angle is used to confirm if the rear axle is parallel to its front axle and to confirm if a wheelbase on both sides of the vehicle is inline. Thrust angle is an angle made by an imaginary line drawn perpendicular to the rear axle and a centerline of the vehicle as shown in Figure 1. Deviation in the thrust angle is caused by everyday use of the vehicle, any collision, and repeated impacts due road conditions such as uneven potholes or hard bumps. An increase in the thrust angle will alter drivability, and the driver will experience a sense handling abnormality like a pull in one direction of the vehicle, and/or different vehicle behavior when turning left or right. Therefore, thrust angle is considered one of the most important diagnostic angles during any wheel/ axle alignment.

[003] Elimination of an improper thrust angle is a difficult task, which might require significant repair to bring the axle(s) back into proper alignment. Conventionally, wheel alignment jacks are used for correcting the thrust angle. These wheel alignment jacks have two curved arms, which can be positioned between the tires (wheels) of two rear axle, for applying a leverage against the tires and to adjust the thrust angles. These curved arms are hydraulically operated by a foot pedal and are configured to move away from each other to apply the leverage against the tires until a desired thrust angle is reached. However, these conventional wheel alignment jacks damage the tires of the vehicle, as the curved arms exert very high force on the tires during thrust angle correction. As a result, the life of the tire after correction is significantly reduced. Moreover, accuracy in correction of the thrust angle with the conventional wheel alignment jacks is very poor.

SUMMARY OF THE INVENTION

[004] In an embodiment, a device for correcting deviation in thrust angle of an axle of a multi axle vehicle is disclosed. The device may include a platform defined with a base and

a support member extending upwardly from the base. Further, a cylinder assembly is secured to the support member. The support member is configured to position the cylinder assembly perpendicularly between at least two axles of the multi axle vehicle. The cylinder assembly comprises a cylinder defined with a chamber. The cylinder assembly includes a pair of pistons movably positioned in the chamber and each of the pair of pistons is movable between an extended position and a retracted position within the chamber. A piston rod projects outwardly from each of the pair of pistons. The device further includes a hydraulic fluid source fluidly connected to the cylinder. The hydraulic fluid source is being configured to supply pressurized hydraulic fluid to the chamber in between the pair of pistons such that hydraulic fluid acts on one side of each of the pair of pistons to actuate the pair of pistons from the retracted position to the extended position. The pair of pistons in the extended position act on the at least one axle to correct the thrust angle. Further, a compressed air source is fluidly connected to the cylinder. The compressed air source is configured to supply compressed air to the chamber such that compressed air acts on other side opposite to the one side of each of the pair of pistons to actuate the pair of pistons from the extended position to the retracted position.

[005] In an embodiment, each of the piston rod is detachably coupled with a shaft that projects outwardly from each end of the cylinder in the extended position such that each shaft is enclosed by a tube connected to the cylinder.

[006] In an embodiment, the hydraulic fluid source comprises a motor for pressurizing the hydraulic fluid. The motor is driven by the compressed air source.

[007] In an embodiment, the device comprises a first port provided on the cylinder and in between the pair of pistons. The first port is fluidly connected to the hydraulic fluid source via the motor to supply pressurized hydraulic fluid into the chamber. Further, a second port is provided on either side of the first port on the cylinder. The second port is fluidly connected to the compressed air source to supply compressed air on other side opposite to the one end of the pair of pistons.

[008] In an embodiment, second port is fluidly connected to the compressed air source via a Tee joint to supply compressed air on other side opposite to the one end of the pair of pistons.

[009] In an embodiment, the first port and the second port are enclosed within a housing. The housing is securely supported by the cylinder assembly.

[010] In an embodiment, a pressure of pressurized hydraulic fluid supplied that acts on one side of each of the pair of pistons is greater than a pressure of compressed air supplied that acts on other side opposite to the one side of each of the pair of pistons.

[011] In an embodiment, at least one first valve is in fluid communication with the hydraulic fluid source and the motor to control the supply of the hydraulic fluid into the motor. Further, at least one second valve is in fluid communication with the compressor air source and the motor to control the supply of compressed air into the motor. Also, at least one third valve is in fluid communication with the compressed air source and the cylinder assembly to control the supply of compressed air into the cylinder via the second port.

[012] In an embodiment, the platform comprises plurality of wheels coupled to a bottom of the base. The wheels are configured to move and position the cylinder assembly perpendicular to the at least two rear axles of the multi axle vehicle.

[013] In an embodiment, the motor is in fluid communication with the cylinder assembly is an air hydraulic motor.

BRIEF DESCRIPTION OF THE DRAWINGS

[014] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

[015] **Figure 1** illustrates a schematic view of a thrust angle formed by axle between at least two axles of a vehicle, in accordance with an embodiment of the present disclosure;

[016] **Figure 2** illustrates a schematic bottom prespective view of a device configured between at least two axles of a vehicle, in accordance with an embodiment of the present disclosure;

[017] **Figure 3** illustrates a schematic sectional view of a cylinder assembly the device used for correcting the thrust angle in extended position of, in accordance with an embodiment of the present disclosure;

[018] **Figure 4** illustrates a schematic sectional view of the cylinder assembly of Figure. 2 in retracted position;

[019] **Figure 5** illustrates a schematic view of the device of Figure. 1; and

[020] **Figure 6** illustrates a fluid circuit diagram of a hydraulic fluid source and a compressed air source connected with the cylinder assembly, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DRAWINGS

[021] Exemplary embodiments are described with reference to the accompanying drawings. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without

departing from the scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope being indicated by the following claims. Additional illustrative embodiments are listed.

[022] Embodiments of the present disclosure disclose a device for correcting deviation in thrust angle of an axle of a multi axle vehicle which is efficient and accurate. The device is also compact and can be accommodated on axles of the vehicle unlike arranging on tires, thereby preventing potential damage to the tires. The device operates in combination of hydraulic and air pressure which is inexpensive for thrust angle correction.

[023] The following paragraphs describe the present disclosure with reference to Figures.1 to 5. In the figures, the same element or elements which have similar functions are indicated by the same reference signs.

[024] Referring to **Figure 1** and **Figure 6** which are exemplary embodiments of the present disclosure illustrating a device for correcting deviation in thrust angle of an axle 210 of a multi axle vehicle 200 [also referred as "device 100"]. As will be understood, the device 100 may be configured for vehicle comprising multiple axles and may be employed in any type of vehicle having two or more axles at a rear end or a front end of the vehicle. Further, the device 100 may be employed in axles of different types of multi axle vehicle such as fuel based, electric or hybrid electric vehicles.

[025] As shown in Figure. 2, the vehicle 200 includes at least two rear axles 210. The device 100 is positioned between the two rear axles 210 for correcting deviation in thrust angle of one of the axles 210. The device 100 comprises a platform 10 defining a base 11 and a support member 12. The support member 12 extends upwardly from the base 11. In an embodiment, the base 11 includes a bottom and an upper surface. The support member 12 extends from the upper surface of the base 11. The support member 12 is configured to securely support a cylinder assembly 20. The support member 12 may be configured as an elongated member extending upwardly from the base 11 such that cylinder assembly 20 is secured to the support member 12. The support member 12 is configured to position the cylinder assembly 20 perpendicularly between at least two axles 210 of the multi axle vehicle 200. In an embodiment, the support member 12 may be coupled to the cylinder assembly 20 by at least one of fastening, thermal or adhesive means, or provided with a provision to accommodate the cylinder assembly 20 or by arranging a supporting bracket to allow coupling of the cylinder assembly 20 with the support member 12. Further, the platform 10 includes a plurality of wheels 90 that are coupled to the bottom surface of the base 11. The plurality of wheels 90 allow movement of the platform 10 supporting the cylinder assembly 20. This facilitates

positioning of the cylinder assembly 20 perpendicular to the at least two rear axles 210 of the multi axle vehicle 200. Further, the plurality of wheels 90 can be for example, a castor wheel or any other wheel that facilitates the rolling action when in contact with a ground surface. In an embodiment, the platform 10 may include one or more stoppers provided at the base, for removably fixing the platform 20 with the ground surface.

[026] Referring to Figures 3 and 4, the cylinder assembly 20 comprises a cylinder 22 defined with a chamber 24. In an embodiment, the cylinder 22 may be a longitudinally extending in the mid-section. In an embodiment, at least one tube is defined at a first end 22a and a second end 22b of the cylinder having the chamber 24 therebetween. The chamber 24 is configured to accommodate a pair of pistons 25. The pair of pistons 25 is movably positioned in the chamber 24 such that each of the pair of pistons 25 is movable between an extended position (Figure 3) and a retracted position (Figure 4). Each of the piston of the pair of pistons 25 are configured such that one side 25a of the piston 25 face towards each other. Further, other side 25b opposite to the one side 25a of the each of the pair of pistons 25 is connected to a piston rod 26. The piston rod 26 projects outwardly from each of the pair of pistons 25. The piston rods 26 are enclosed by a cover connected to the cylinder 22. In an embodiment, the at least one tube may be coupled by at least one of mechanical fastening means, thermal or adhesive means. Further, each of the pair of piston rod 26 is detachably coupled with a shaft 27. The shaft 27 projects outwardly from a respective piston rod 26. In an embodiment, each shaft 27 may extend outwardly from each end of the at least one tube connected to first end 22a and second end 22b of the cylinder 22, respectively. Further, each shaft 27 is coupled to the each of the piston rod 26 such that each shaft 27 are configured opposite to each other and are enclosed by the cylinder 22. In an embodiment, each of shaft 27 and the pair of the piston rods 26 are provided with complementary threaded grooves to couple with each other. In an extended position, the pair of pistons 25 are configured to move away from each other causing connected the piston rod 26 the shaft 27 to extend from each end of the at least one tube connected to the first end 22a and the second end 22b of the cylinder 22 as shown in Figure 3.

[027] Further, the device 100 comprises a hydraulic fluid source 30 fluidly connected to the cylinder 22. The hydraulic fluid source 30 is configured to supply pressurized hydraulic fluid to the chamber 24 in between the pair of pistons 25. The hydraulic fluid source 30 include a tank to store the hydraulic fluid. In an embodiment, the hydraulic fluid may have a viscosity suitable to acts on the pair of pistons 25. The hydraulic fluid source 30 also includes a motor 60 fluidly coupled the tank and configured to the pressurize the fluid supplied to the chamber 24. In an embodiment, the first port 50 is provided on the cylinder 22 in between the

pair of pistons 25. The hydraulic fluid acts on one side 25a of each of the pair of pistons 25 to actuate the pair of pistons 25 from the retracted position to the extended position. Thus, the pair of pistons 25 in the extended position act on the at least one axle 210 to correct the thrust angle.

[028] The device further includes a compressed air source 40 fluidly connected to the cylinder 22. The compressed air source 40 is configured to supply compressed air to the chamber 24. In an embodiment, the compressed air source 40 may include a compressor which may be at least one of rotary screw, vane, reciprocating air compressors and the like. The compressed air is supplied to the chamber 24 through a second port 55. In an embodiment, the second port 50 is provided on either side the cylinder 22. The compressed air acts on other side 25b opposite to the one side 25a of each of the pair of pistons 25 to actuate the pair of pistons 25 from the extended position to the retracted position. The second port 55 is fluidly connected to the compressed air source 40 via a Tee joint 56 to supply compressed air on other side 25b opposite to the one end 25a of the pair of pistons 25. In an embodiment, each of the second port 55 is fluidly connected to the Tee join 56 through a conduit. The first and the second port may be in fluid communication with the hydraulic fluid source 30 and the compressed air source 40 via at least one duct 31, 41 respectively. The first port 50 and the second port 55 are enclosed within a housing 58. The housing 58 is securely supported by the cylinder assembly 20.

[029] Referring to Figure 6, the device 100 comprises valves in fluid communication with the hydraulic fluid source 30 and the compressed air source 40 to control the supply of the hydraulic fluid and compressed air into the chamber 24. In an embodiment, the device 100 comprises at least one first valve 70 in fluid communication with the tank and the motor 60 to control the supply of the hydraulic fluid via the motor 60 into the first port 50. The at least one first valve 70 is disposed between the tank and the motor 60. Further, at least one second valve 75 in fluid communication with the compressor air source 40 and the motor 60. This second valve 75 is configured to control the supply of compressed air into the motor 60 to operate the motor 60 to allow suction of the hydraulic fluid from the hydraulic fluid source 30 and into the cylinder 22 via the first port 50. The at least one second valve 75 is disposed between compressed air source 40 and the motor 60. In an embodiment, the hydraulic fluid source (30) in fluid communication with the motor (60) for pressurizing the hydraulic fluid. Further, the motor (60) is driven by the compressed air source (40). This air hydraulic motor 60 comprises at least one provision to receive and utilize the compressed air supplied from the compressed air source 40 for pumping /suction of the hydraulic fluid from the tank, thereby pressurizing

the hydraulic fluid. A second provision may be provided on the motor 60 to facilitate supply of pressurized hydraulic fluid into the chamber 24 via the first port 50. The device also includes at least one third valve 80 in fluid communication with the compressed air source 40 and the cylinder assembly 20 to control the supply of compressed air into the cylinder 22 via the second port 55. The at least one third valve 80 is disposed between the compressed air source 40 and the cylinder assembly 20. In an embodiment, a pressure of pressurized hydraulic fluid that acts on one side 25a of each of the pair of pistons 25 is greater than a pressure of compressed air that acts on other side 25b opposite to the one side 25a of each of the pair of pistons 25. In some embodiments, the pressure of the hydraulic fluid may range about 350 Bar to 450 Bar. The pressure of the compressed air may range about 8 Bars to 10 Bars. In an embodiment, the compressed air source 40 and the motor 60 are provided within an enclosure 42 and configured above the hydraulic fluid source 30 as shown in Figure 5. This configuration allows ease of access of motor 60 with the compressed air source 40 and the hydraulic fluid source 30, thereby reduces number of fluid connections.

[030] In an operational embodiment, the device having the cylinder assembly 20 may be towards the axles of the vehicle 200 and is positioned perpendicularly between at least two axles 210. The device includes a lever or push pedal (not shown in Figures) coupled with the cylinder assembly 20 and connected to the hydraulic fluid source 30 and the air compressor 40 such that pressing of the lever/push pedal allows supply of pressurized hydraulic fluid into the chamber 24. This pressurized fluid acts on one side 25a of each of the pair of pistons 25 causing the pistons to slidably move away from each other. This results in shafts 27 to moves towards ends of the cylinder in the extended position thereby correcting the thrust angle of the one axle of the at least two axles, such that the other axle of the at least two axles may act as a support. Further, once the shafts 27 are in extended position, the lever/the push pedal is pressed to cause the compressed air source 40 to supply compressed air into the chamber 24 using the second port 55 that acts on other side 25b opposite to the one side 25a of each of the pair of pistons 25. This pressure of compressed air will cause each of the pair pistons 25 to slidably move towards each other, thereby retracting each shaft 27 within the cylinder 22. The cylinder assembly 20 may be defined with one or more sleeves 29 provided at each end of the cylinder 22 to restrict an extension of each shaft 27 with respect to the cylinder 22 to desired distance. The sleeves may be provided with damping members to absorb impact and forces generated due to movement of the shafts 27 towards extended position. Also, the pair of pistons 25 are provided with sealing rings.

[031] In an embodiment, size of the cylinder assembly 20 having the pair of pistons 25, piston rod 26 and the shafts 27 may vary depending on the application. In an embodiment, a plurality of seals may be provided over the pair of pistons 25 for fluidly seal of each side of the pair of pistons 25 about the cylinder 22. Further, the plurality of seals may be provided over the shaft to fluidly seals with the at least one tube to prevent leakage of pressurized fluid into the at least one tube and the compressed air into mid-section of the cylinder 22, when the device is operational between extended position and retracted position.

[032] The above subject matter discloses a device 100 which provides ease of handling and without a need of skilled person to operate. Further, device 100 includes a cylinder assembly, that is easy to assemble thereby reducing overall manufacturing and operating costs. Further, the device 100 delivers accurate thrust angle correction as the device is directly mounted between the two axles 210. Moreover, by employing the pressurized hydraulic fluid and compressed air to slidably move pair of pistons enables less consumption of energy and power to drive the device.

[033] It is intended that the disclosure and examples be considered as exemplary only, with a true scope of disclosed embodiments being indicated by the following claims.

List of reference numerals

Reference number	Description
100	Device for correcting deviation in thrust angle
200	Vehicle
210	Axle of the vehicle
10	Platform
11	Base
12	Support member
20	Cylinder assembly
22	Cylinder
22a	First end of cylinder
22b	Second end of cylinder
24	Chamber
25	Pair of pistons
25a	One side of pair of pistons
25b	Other side of pair of pistons
26	Pair of pistons
27	Shaft
29	Sleeves
30	Hydraulic fluid source

31	At least one duct
40	Compressed air source
41	At least one duct
42	Enclosure
50	First port
55	Second port
56	Tee Coupler
58	Housing
60	Motor
70	At least one first valve
75	At least one second valve
80	At least one third valve
90	Plurality of wheels

WE CLAIM:

1. A device (100) for correcting deviation in thrust angle of an axle (210) of a multi axle vehicle (200), the device (100) comprising:

a platform (10) defined with a base (11) and a support member (12) extending upwardly from the base (11);

a cylinder assembly (20) secured to the support member (12), wherein the support member (12) being configured to position the cylinder assembly (20) perpendicularly between at least two axles (210) of the multi axle vehicle (200), the cylinder assembly (20) comprising:

a cylinder (22) defined with a chamber (24);

a pair of pistons (25) movably positioned in the chamber (24), wherein each of the pair of pistons (25) movable between an extended position and a retracted position within the chamber (24);

a piston rod (26) projecting outwardly from each of the pair of pistons (25);

a hydraulic fluid source (30) fluidly connected to the cylinder (22), wherein the hydraulic fluid source (30) being configured to supply pressurized hydraulic fluid to the chamber (24) in between the pair of pistons (25) such that hydraulic fluid acts on one side (25a) of each of the pair of pistons (25), to actuate the pair of pistons (25) from the retracted position to the extended position, wherein the pair of pistons (25) in the extended position act on the at least one axle (210) to correct the thrust angle; and

a compressed air source (40) fluidly connected to the cylinder (22), wherein the compressed air source (40) being configured to supply compressed air to the chamber (24) such that compressed air acts on other side (25b) opposite to the one side (25a) of each of the pair of pistons (25) to actuate the pair of pistons (25) from the extended position to the retracted position.

2. The device (100) as claimed in claim 1, wherein each of the piston rod (26) is detachably coupled with a shaft (27) that projects outwardly from each end of the cylinder (22) in the extended position such that each shaft (27) is enclosed by a tube connected to the cylinder (22).

3. The device (100) as claimed in claim 1, wherein the hydraulic fluid source (30) comprises a motor (60) for pressurizing the hydraulic fluid, and wherein the motor (60) is driven by the compressed air source (40).

4. The device (100) as claimed in claim 1, comprises

a first port (50) defined in the cylinder (22) in between the pair of pistons (25), wherein the first port (50) is fluidly connected to the hydraulic fluid source (30) to supply pressurized hydraulic fluid into the chamber (24); and

a second port (55) defined on either side of the first port (50), wherein the each of the second port (55) is fluidly connected to the compressed air source (40) to supply compressed air on other side (25b) opposite to the one end (25a) of the pair of pistons (25).

5. The device as claimed in claim 4, the each of the second port (55) is fluidly connected to the compressed air source (40) via a Tee coupler (56).

6. The device (100) as claimed in claim 1, wherein the first port (50) and the second port (55) are enclosed within a housing (58), wherein the housing (58) is securely supported by the cylinder assembly (20).

7. The device (100) as claimed in claim 1, wherein a pressure of pressurized hydraulic fluid supplied that acts on one side (25a) of each of the pair of pistons (25) is greater than a pressure of compressed air supplied that acts on other side (25b) opposite to the one side (25a) of each of the pair of pistons (25).

8. The device (100) as claimed in claim 4, comprises

at least one first valve (70) in fluid communication with the hydraulic fluid source (30) and the motor (60) to control the supply of the hydraulic fluid into the motor (60),

at least one second valve (75) in fluid communication with the compressed air source (40) and the motor (60), to control the supply of compressed air into the motor (60); and

at least one third valve (80) in fluid communication with the compressed air source (40) and the cylinder assembly (20) to control the supply of compressed air into the cylinder (22) via the second port (55).

9. The device (100) as claimed in claim 1, wherein the platform (10) comprises plurality of wheels (90) coupled to a bottom surface of the base (11), wherein the plurality of wheels (90) is configured to move and position the cylinder assembly (20) perpendicular to the at least two rear axles (210) of the multi axle vehicle (200).

10. The device (100) as claimed in claim 1, wherein the motor (60) in fluid communication with the cylinder assembly (20) is an air hydraulic motor.

Dated this 25th day of April 2022

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ABSTRACT

A DEVICE FOR CORRECTING DEVIATION IN THRUST ANGLE OF AN AXLE OF A MULTI AXLE VEHICLE

A device (100) for correcting deviation in thrust angle of an axle (210) of a multi axle vehicle (200) is disclosed. The device (100) includes a platform (10) with a support member (12) extending upwardly to support a cylinder assembly (20). The cylinder assembly (20) is positioned perpendicularly between at least two axles (210) of the vehicle. The cylinder assembly (20) comprises a cylinder (22) with a chamber (24) having a pair of pistons (25) movable between an extended position and a retracted position via a piston rod projecting outwardly. A hydraulic fluid and a compressed air sources are fluidly connected to cylinder (22) for supplying pressurized hydraulic fluid to act on one side of the pair of pistons (25) to actuate from retracted position to extended position to correct the thrust angle. The compressed air is supplied to act on other side (25b) opposite to the one side (25a) of each of the pair of pistons (25) to actuate from the extended position to the retracted position.

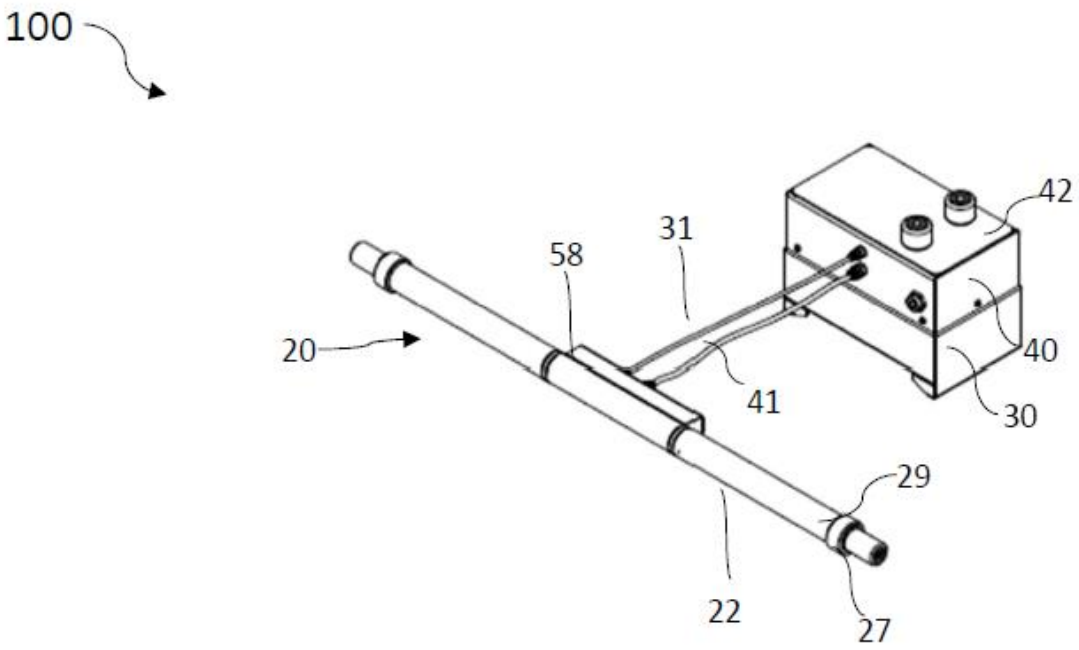

Figure 5

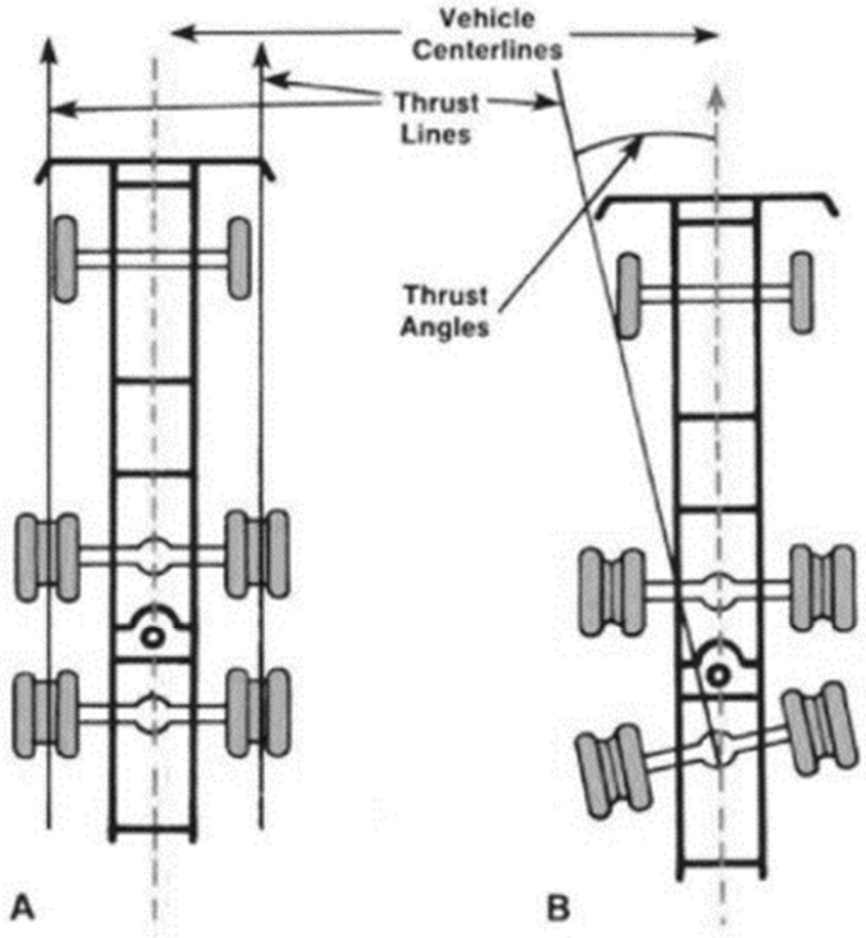

Figure 1 (prior art)

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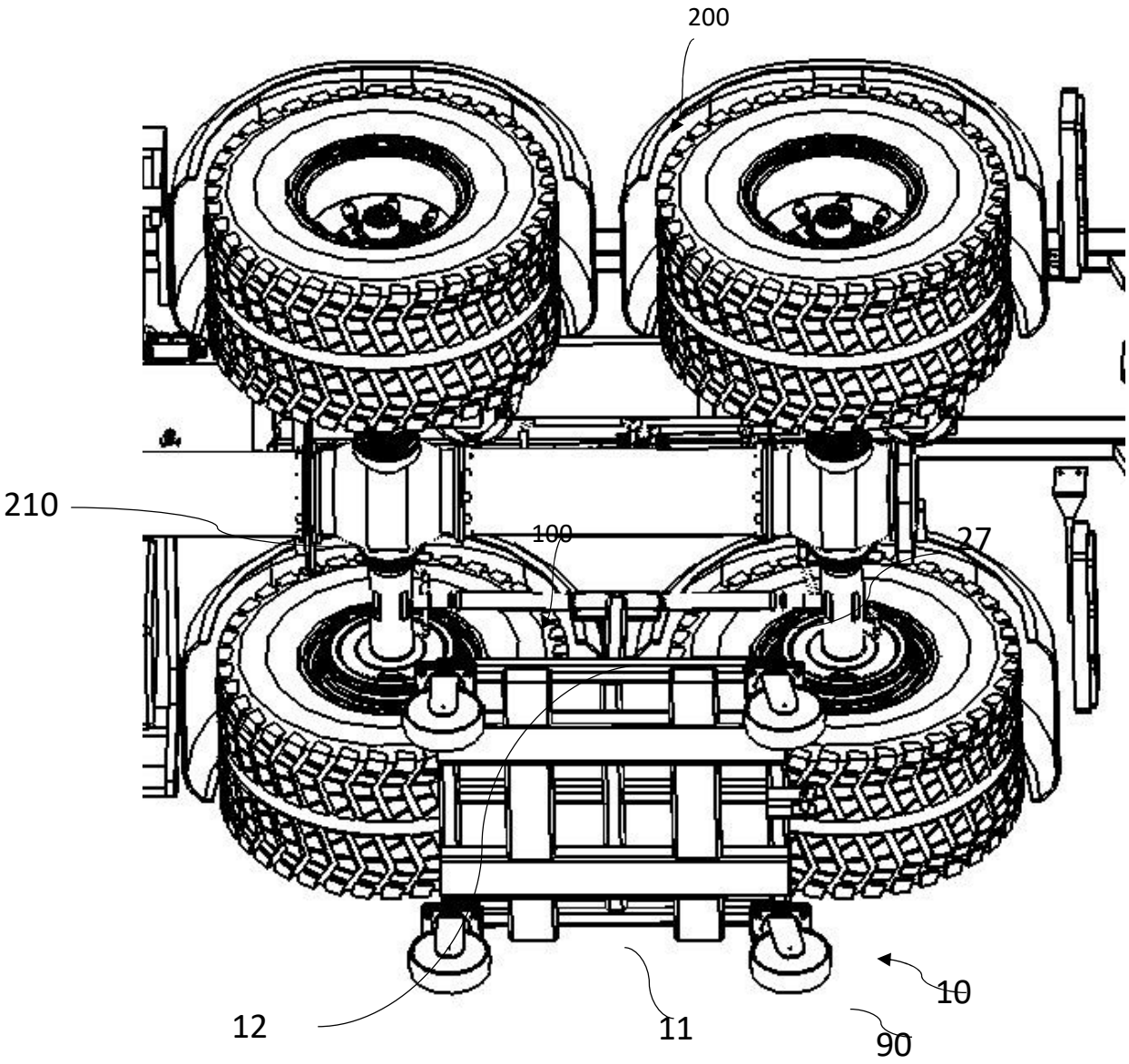

Figure 2

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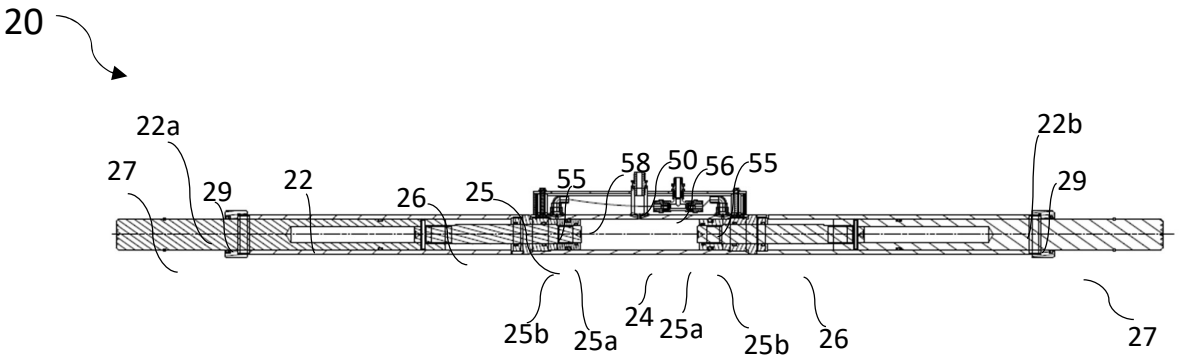

Figure 3

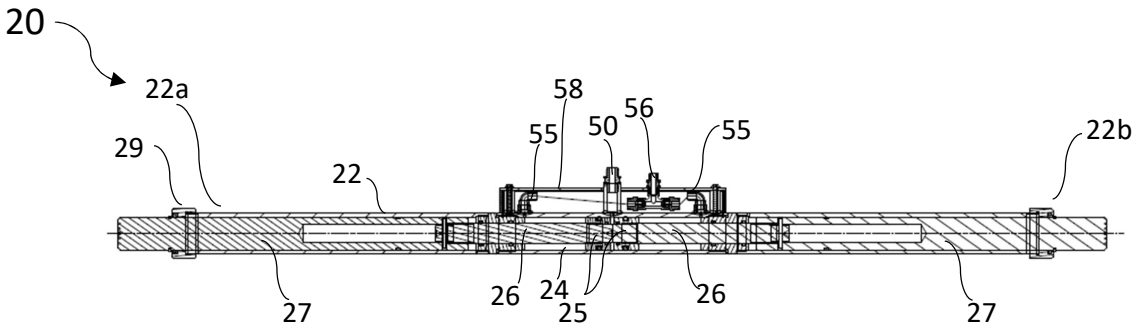

Figure 4

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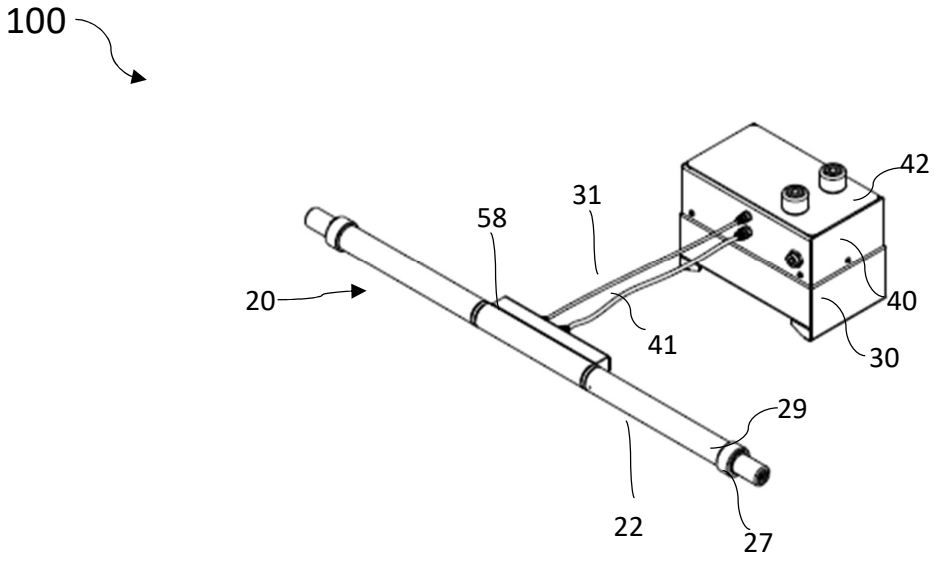

Figure 5

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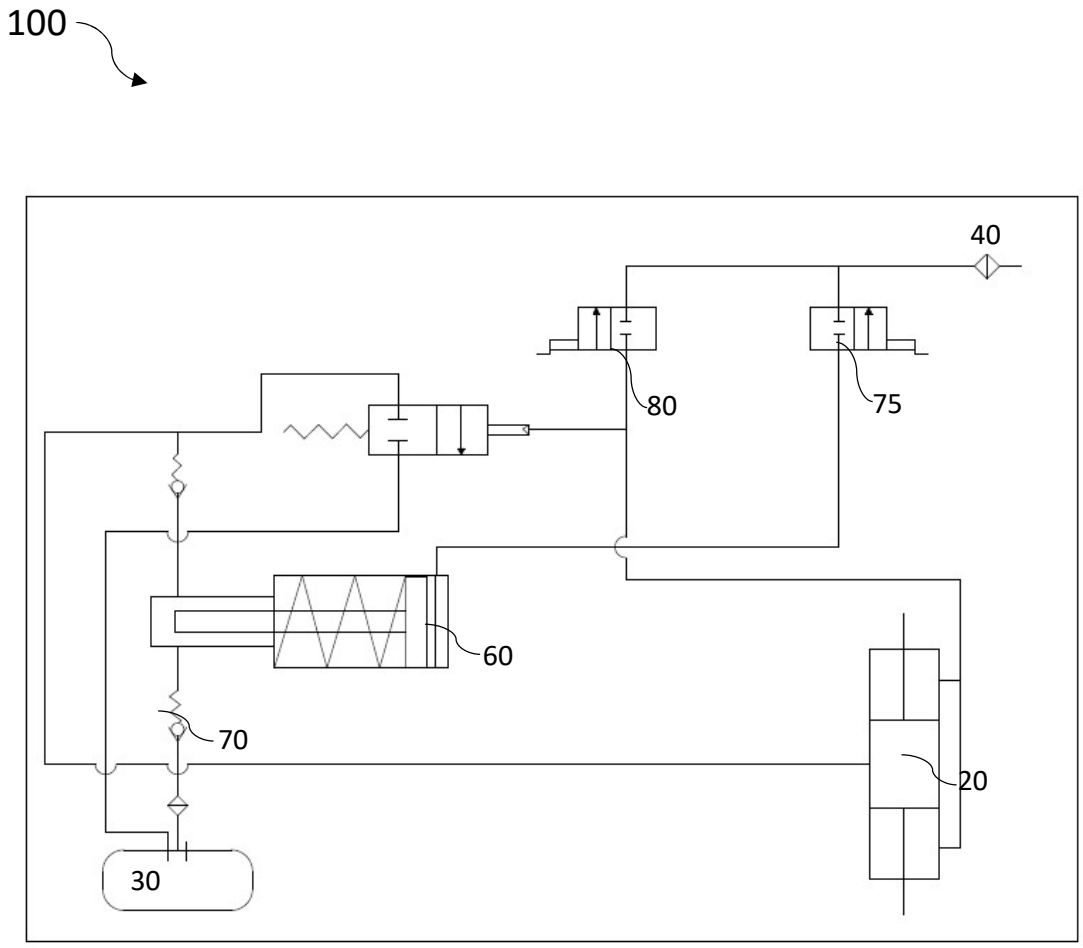

Figure 6

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