(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
04 October 2018 (04.10.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/183302 A1

(51) International Patent Classification:
B60T 7/20 (2006.01) *B60T 15/04* (2006.01)

(21) International Application Number:
PCT/US2018/024532

(22) International Filing Date:
27 March 2018 (27.03.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
15/470,208 27 March 2017 (27.03.2017) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

(54) Title: VALVE SYSTEM AND METHOD FOR CONTROLLING THE SAME

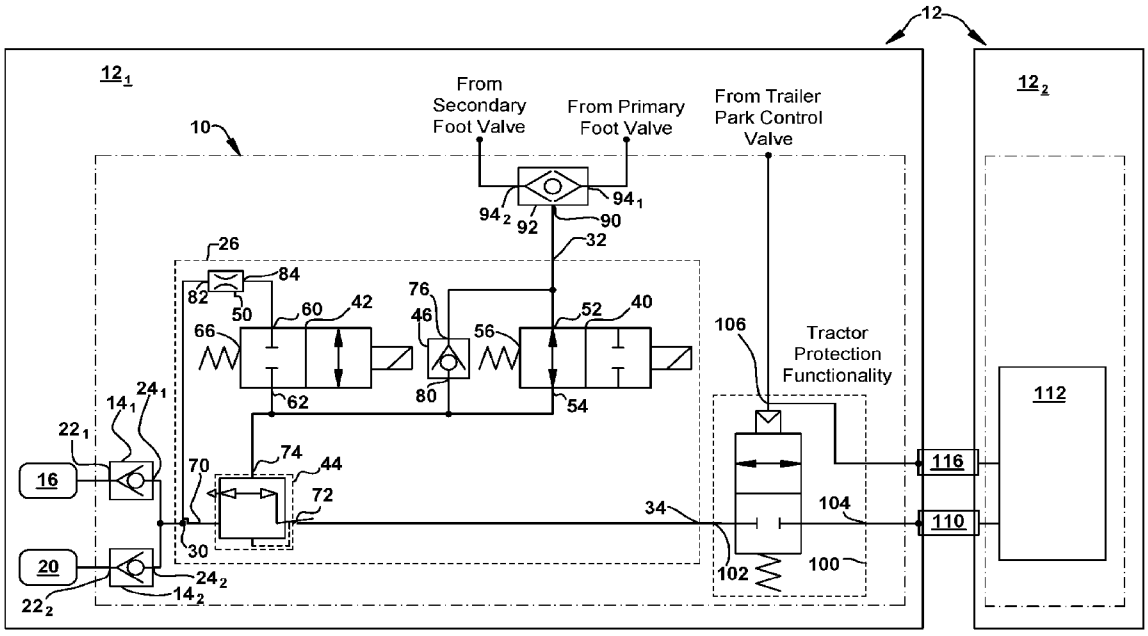


FIG. 1

(57) Abstract: A valve system includes an isolation check valve delivering pneumatic fluid as a supply pressure, a double-check valve adapted to deliver a braking demand control signal of the pneumatic fluid based on a higher of a first braking demand in a first pneumatic braking circuit and a second braking demand in a second pneumatic braking circuit, and a control module. The control module is adapted to receive the supply pressure as a control module supply pressure of the pneumatic fluid, receive a control module control pressure of the pneumatic fluid based on the braking demand control signal, and deliver a control module delivery pressure of the pneumatic fluid based on the control module supply pressure and the control module control pressure. A tractor protection module delivers the pneumatic fluid at the control module delivery pressure based on a trailer park brake pressure of the pneumatic fluid.

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SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

VALVE SYSTEM AND METHOD FOR CONTROLLING THE SAME

Background

[0001] The present invention relates to a tractor protection function. It finds particular application in conjunction with delivering pneumatic fluid from a tractor to a trailer based on a trailer park brake pressure and will be described with particular reference thereto. It will be appreciated, however, that the invention is also amenable to other applications.

[0002] Current trailer control strategies involve using a relay valve to apply full system air pressure to a supply port of an antilock braking system (ABS) modulator. The ABS modulator is set to hold off pressure, and pulses to send a set volume of air into the trailer control line to apply trailer brakes. However, there is no mechanism to compensate for any loss of air volume in the trailer and/or verify that the required air pressure has been delivered to the trailer.

[0003] The present invention provides a new and improved apparatus and method for compensating for any loss of air volume in the trailer and/or verifying that the required air pressure has been delivered to the trailer.

Summary

[0004] In one aspect of the present invention, it is contemplated that a valve system includes an isolation check valve delivering pneumatic fluid as a supply pressure, a double-check valve adapted to deliver a braking demand control signal of the pneumatic fluid based on a higher of a first braking demand in a first pneumatic braking circuit and a second braking demand in a second pneumatic braking circuit, and a control module. The control module is adapted to receive the supply pressure as a control module supply pressure of the pneumatic fluid, receive a control module control pressure of the pneumatic fluid based on

the braking demand control signal, and deliver a control module delivery pressure of the pneumatic fluid based on the control module supply pressure and the control module control pressure. A tractor protection module delivers the pneumatic fluid at the control module delivery pressure based on a trailer park brake pressure of the pneumatic fluid..

Brief Description of the Drawings

[0005] In the accompanying drawings which are incorporated in and constitute a part of the specification, embodiments of the invention are illustrated, which, together with a general description of the invention given above, and the detailed description given below, serve to exemplify the embodiments of this invention.

[0006] **FIGURE 1** illustrates a schematic representation of a simplified component diagram of an exemplary valve system in a first state while an associated vehicle is in a first state in accordance with one embodiment of an apparatus illustrating principles of the present invention;

[0007] **FIGURE 2** illustrates a schematic representation of a simplified component diagram of an exemplary valve system in the first state while the associated vehicle is in a second state in accordance with one embodiment of an apparatus illustrating principles of the present invention;

[0008] **FIGURE 3** is an exemplary methodology of controlling the valve system in accordance with one embodiment illustrating principles of the present invention;

[0009] **FIGURE 4** illustrates a schematic representation of a simplified component diagram of an exemplary valve system in a second state while the associated vehicle is in the second state in accordance with one embodiment of an apparatus illustrating principles of the present invention; and

[0010] **FIGURE 5** illustrates a schematic representation of a simplified component diagram of an exemplary valve system in a third state while the associated vehicle is in the second state in accordance with one embodiment of an apparatus illustrating principles of the present invention.

Detailed Description of Illustrated Embodiment

[0011] With reference to **FIGURE 1**, a simplified component diagram of an exemplary valve system **10** is illustrated in accordance with one embodiment of the present invention. The valve system **10** is part of an associated vehicle combination **12**, which includes a tractor $\mathbf{12_1}$ and a trailer $\mathbf{12_2}$, and includes at least one isolation check valve $\mathbf{14_1}$, $\mathbf{14_2}$ (e.g., two (2) check valves collectively referenced as **14**). The first isolation check valve $\mathbf{14_1}$ receives a pneumatic fluid (e.g., air) from a first source such as, for example, a first reservoir **16**, and the second isolation check valve $\mathbf{14_2}$ receives the pneumatic fluid from a second source such as, for example, a second reservoir **20**. It is to be assumed that the first and second reservoirs **16, 20** are part of respective fluidly independent pneumatic circuits . The first isolation check valve $\mathbf{14_1}$ includes a first pneumatic supply port $\mathbf{22_1}$ and a first pneumatic delivery port $\mathbf{24_1}$. The second isolation check valve $\mathbf{14_2}$ includes a second pneumatic supply port $\mathbf{22_2}$ and a second pneumatic delivery port $\mathbf{24_2}$. The first pneumatic delivery port $\mathbf{24_1}$ fluidly communicates with the second pneumatic delivery port $\mathbf{24_2}$. A higher of the respective pressures (e.g., supply pressures) of the pneumatic fluid at the first and second pneumatic supply ports $\mathbf{22_{1,2}}$ is present at both the first and second pneumatic delivery ports $\mathbf{24_{1,2}}$.

[0012] A control module **26** includes a supply port **30**, a control port **32**, and a delivery port **34**. The control module **26** also includes a first control valve **40**, a second control valve **42**, a relay valve **44**, a control module check valve **46**, and a restrictor **50**. The first control valve **40** includes a supply port **52** (e.g., a pneumatic supply port), a delivery port **54** (e.g., a pneumatic delivery port) and a control port **56** (e.g., an electrical control

port). The second control valve **42** includes a supply port **60** (e.g., a pneumatic supply port), a delivery port **62** (e.g., a pneumatic delivery port) and a control port **66** (e.g., an electrical control port). The relay valve **44** includes a supply port **70** (e.g., a pneumatic supply (input) port), a delivery port **72** (e.g., a pneumatic delivery (output) port), and a control port **74** (e.g., a pneumatic control port). The check valve **46** includes a pneumatic supply port **76** (e.g., input port) and a pneumatic delivery port **80** (e.g., output port). The restrictor **50** includes an pneumatic supply port **82** (e.g., input port) and a pneumatic delivery port **84** (e.g., output port).

[0013] In the illustrated embodiment, both the relay valve supply port **70** and the restrictor input port **82** fluidly communicate with the control module supply port **30**. Both the first control valve supply port **52** and the check valve supply port **76** fluidly communicate with the control module control port **32**. Each of the first control valve delivery port **54**, the second control valve delivery port **62** and the check valve delivery port **80** fluidly communicates with relay valve control port **74**. The check valve **46** opens to permit fluid communication between the check valve supply port **76** and the check valve delivery port **80** when a pressure of the pneumatic fluid at the check valve supply port **76** is greater than a pressure at the check valve delivery port **80** by a predetermined amount; otherwise, the check valve **46** remains closed to prevent fluid communication between the check valve supply port **76** and the check valve delivery port **80**. The relay valve delivery port **72** fluidly communicates with the control module delivery port **34**.

[0014] The higher of the respective supply pressures of the pneumatic fluid at the first and second pneumatic supply ports $\mathbf{22_{1,2}}$, which is present at both the first and second pneumatic delivery ports $\mathbf{24_{1,2}}$, is fluidly communicated to the control module supply port **30** as a control module supply pressure. The control module supply pressure is, therefore, fluidly communicated to the restrictor input port **82** and the relay valve supply port **70**. The restrictor output port **84** fluidly communicates the control module supply pressure to the second control valve supply port **60**. The restrictor **50** slows airflow from the first and second reservoirs **16, 20** to help control the second control valve **42**. In addition, the

restrictor **50** allows a leak from the supply port **60** to the control port **62** of the second control valve **42** to exhaust through the delivery port **54** of the first control valve **40** before such a leak acts on the control port **74** of the relay valve **44**.

[0015] The control module control port **32** receives a pneumatic control signal, based on a level of operator demanded braking, from an output port **90** of a double check valve **92**. For example, the operator of an associated vehicle combination **12** depresses a pedal of a foot valve (not shown) to demand braking. The level of the operator demanded braking is dependent on an amount the pedal is depressed. The pneumatic fluid from the first and second reservoirs **16, 20** is fluidly transmitted to respective first and second input ports $\mathbf{94_1}$, $\mathbf{94_2}$ of the double check valve **92** based on the level of operator demanded braking. The higher of the respective pneumatic pressures at the first and second input ports $\mathbf{92_1}$, $\mathbf{92_2}$ is fluidly communicated to the double check valve output port **90** and, therefore, to the control module control port **32**. The higher of the respective pneumatic pressures at the first and second input ports $\mathbf{92_1}$, $\mathbf{92_2}$ is also fluidly communicated from the control module control port **32** to both the first control valve supply port **52** and the check valve supply port **76**.

[0016] A tractor protection module **100** includes a supply port **102** (e.g., input), a delivery port **104** (e.g., output) and a control port **106**. The tractor protection supply port **102** fluidly communicates with the tractor protection delivery port **104** based on a pneumatic pressure at the tractor protection control port **106**. In one embodiment, the pneumatic pressure at the tractor protection control port **106** is received from a trailer park control valve (not shown) and is referred to as a trailer park brake pressure. The trailer park brake pneumatic pressure at the tractor protection control port **106** (e.g., trailer park brake pressure) is at least a predetermined threshold if the associated vehicle combination **12** is in an unparked state (see **FIGURE 2**) and below the predetermined threshold if the associated vehicle combination **12** is in a parked state (see **FIGURE 1**). While the vehicle combination **12** is in the unparked state (see **FIGURE 2**), the tractor protection supply port **102** fluidly communicates with the tractor protection delivery port **104** so that the pneumatic pressure at the tractor protection supply port **102** is fluidly communicated to the tractor protection

delivery port **104**, during which time the tractor protection module is also in an unparked state. While the vehicle combination **12** is in the parked state, as illustrated in **FIGURE 1**, the tractor protection supply port **102** does not fluidly communicate with the tractor protection delivery port **104**, during which time the tractor protection module is also in an parked state.

[0017] With reference to **FIGURE 3**, an exemplary methodology of the operation of the valve system **10** shown in **FIGURES 1, 2, 4 and 5** is illustrated. As illustrated, the blocks represent functions, actions and/or events performed therein. It will be appreciated that electronic and software systems involve dynamic and flexible processes such that the illustrated blocks and described sequences can be performed in different sequences. It will also be appreciated by one of ordinary skill in the art that elements embodied as software may be implemented using various programming approaches such as machine language, procedural, object-oriented or artificial intelligence techniques. It will further be appreciated that, if desired and appropriate, some or all of the software can be embodied as part of a device's operating system.

[0018] With reference to **FIGURES 1–5**, the operation starts in a step **210**. Then, in a step **212**, the status of the tractor protection module **100** is detected. For example, the status of the tractor protection module **100** is detected in the step **212** as either "unparked" (see **FIGURE 2**) or "parked" (see **FIGURE 1**). In a step **214**, a current braking mode is determined. For example, one of the following three (3) current braking modes is identified in the step **214**: an operator initiated braking mode (see **FIGURES 1 and 2**), a system increasing pressure mode (see **FIGURE 5**), and a system holding pressure mode (see **FIGURE 4**). During the operator initiated braking mode (see **FIGURES 1 and 2**), the amount of braking of the associated vehicle combination **12** is based on how much the operator depresses the pedal of the foot valve. During the system increasing pressure mode (see **FIGURE 5**), the amount of braking of the associated vehicle combination **12** is being increased by an automatic braking system (e.g., antilock braking system (ABS), electronic braking system (EBS), etc). During the system holding pressure mode (see **FIGURE 4**), the

amount of braking of the associated vehicle combination **12** is being held by the automatic braking system (e.g., antilock braking system (ABS), electronic braking system (EBS), etc).

[0019] Then, in a step **216**, the first and second control valves **40, 42**, respectively, are electronically controlled to be set in respective states based on the current braking mode. For example, if the current braking mode is the operator initiated braking mode (see **FIGURES 1 and 2**), then in the step **216** the first control valve **40** is set to an open state and the second control valve **42** is set to a closed state. If the current braking mode is the system increasing pressure mode (see **FIGURE 5**), then in the step **216** the first control valve **40** is set to a closed state and the second control valve **42** is set to an open state. If the current braking mode is the system holding pressure mode (see **FIGURE 4**), then in the step **216** both the first and second control valves **40, 42**, respectively, are set to the closed state.

[0020] While in the open state, the first control valve **40** is set so that the first control valve supply port **52** fluidly communicates with the first control valve delivery port **54**. Similarly, while in the open state, the second control valve **42** is set so that the second control valve supply port **60** fluidly communicates with the second control valve delivery port **62**. While in the closed state, the first control valve **40** is set so that the first control valve supply port **52** does not fluidly communicate with the first control valve delivery port **54**. Similarly, while in the closed state, the second control valve **42** is set so that the second control valve supply port **60** does not fluidly communicate with the second control valve delivery port **62**.

[0021] In a step **220**, the relay valve control port **74** receives a relay valve control pressure from at least one of the first control valve **40**, the second control valve **42** and the check valve **46**. For example, if the first control valve **40** is set to the open state and the second control valve **42** is set to a closed state (e.g., if the current braking mode is the operator initiated braking mode), the relay valve control pressure is received from the first control valve **40** and represents the level of operator demanded braking. If the first control valve **40** is set to the closed state and the second control valve **42** is set to a open state (e.g., if

the current braking mode is the system increasing pressure braking mode), the relay valve control pressure is received from the second control valve **42** and represents the level of system demanded braking. If both the first control valve **40** is set to the closed state and the second control valve **42** is set to a closed state (e.g., if the current braking mode is the system holding pressure braking mode), the relay valve control pressure is received from the check valve **46** and represents the level of system demanded braking during, for example, a hill start assist or a level of operated demanded braking during an operator override mode.

[0022] In a step **222**, the relay valve **44** passes the pneumatic pressure at the control module supply port **30** to the control module delivery port **34** based on the pneumatic pressure received at the relay valve control port **74**.

[0023] In one embodiment, the pneumatic pressure at the control module supply port **30** is passed to the control module delivery port **34** when the pneumatic pressure at the relay valve control port **74** is above a pressure at the control module delivery port **34**. It is also contemplated in this embodiment that the pneumatic pressure at the control module supply port **30** is not passed to the control module delivery port **34** (e.g., the pneumatic pressure at the relay valve control port **74** is about zero (0) psi) when the pneumatic pressure at the relay valve control port **74** is not above the pressure at the relay valve delivery port **72**.

[0024] In another embodiment, the pneumatic pressure passed from the control module supply port **30** to the control module delivery port **34** changes as the pneumatic pressure at the relay valve control port **74** changes.

[0025] In a step **224**, the pneumatic pressure at the control module delivery port **34** is delivered to the control module delivery port **34** and, consequently, the tractor protection module supply port **102**.

[0026] Then, in a step **226**, the pneumatic pressure at the tractor protection module supply port **102** is delivered to the tractor protection delivery port **104** based on the status of the tractor protection module **100** detected in the step **212**. For example, if the status of the

tractor protection module **100** is unparked (see **FIGURE 2**), the pneumatic pressure at the tractor protection delivery port **104** is transmitted, during the step **226**, to a control glad-hand **110**, which fluidly communicates with a park brake system **112** on the trailer $\mathbf{12_2}$ of the vehicle combination **12**. A supply glad-hand **116** fluidly communicates with park brake system **112**. The park brake system **112** on the trailer $\mathbf{12_2}$ is controlled based on the pneumatic pressure delivered from the tractor protection delivery port **104**. On the other hand, if the status of the tractor protection module **100** is parked (see **FIGURE 1**), the pneumatic pressure at the tractor protection delivery port **104** is not transmitted to the control glad-hand **110** during the step **226**.

[0027] The operation stops in a step **230**.

[0028] In one embodiment, it is contemplated that the at least one isolation check valve **14**, the first control valve **40**, the second control valve **42**, the control module check valve **46**, the relay valve **44** and the tractor protection module **100** act as a means for controlling the pressure at the delivery port **104** of the tractor protection module **100**.

[0029] While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.

I/We claim:

1. A valve system, including:

an isolation check valve delivering pneumatic fluid as a supply pressure;

a double-check valve adapted to deliver a braking demand control signal of the pneumatic fluid based on a higher of a first braking demand in a first pneumatic braking circuit and a second braking demand in a second pneumatic braking circuit;

a control module adapted to:

receive the supply pressure as a control module supply pressure of the pneumatic fluid;

receive a control module control pressure of the pneumatic fluid based on the braking demand control signal; and

deliver a control module delivery pressure of the pneumatic fluid based on the control module supply pressure and the control module control pressure; and

a tractor protection module delivering the pneumatic fluid at the control module delivery pressure based on a trailer park brake pressure of the pneumatic fluid

2. The valve system as set forth in claim 1, wherein:

if the trailer park brake pressure is above a predetermined tractor protection supply pressure, the tractor protection module delivers the pneumatic fluid at the control module delivery pressure.

3. The valve system as set forth in claim 2, wherein:

if the trailer park brake pressure is not above the predetermined tractor protection supply pressure, the tractor protection module does not deliver the pneumatic fluid.

4. The valve system as set forth in claim 1, wherein the control module includes a relay valve adapted to:

receive a relay valve supply pressure of the pneumatic fluid based on the control module supply pressure;

receive a relay valve control pressure of the pneumatic fluid based on one of i) the braking demand control signal and the ii) control module supply pressure; and

deliver a relay control pressure of the pneumatic fluid, based on the relay valve supply pressure and the relay valve control pressure, as the control module delivery pressure.

5. The valve system as set forth in claim 4, wherein the control module further includes:

a first control valve set to fluidly communicate the braking demand control signal as the relay valve control pressure based on a current braking mode; and

a second control valve set to fluidly communicate the control module supply pressure as the relay valve control pressure based on the current braking mode.

6. The valve system as set forth in claim 5, wherein:

the current braking mode is one of an operator initiated braking mode, a system increasing pressure mode, and a system holding pressure mode;

the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure, while the second control valve set to not fluidly communicate the control module supply pressure as the relay valve control pressure, if the current braking mode is the operator initiated braking mode;

the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure, while the first control valve is set to not fluidly communicate the braking demand control signal as the relay valve control pressure, if the current braking mode is the system increasing pressure mode; and

neither the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure nor the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure if the current braking mode is the system holding pressure mode.

7. The valve system as set forth in claim 6, the control module further including:

a check valve adapted to fluidly communicate the braking demand control signal as the relay valve control pressure during the system holding pressure mode.

8. The valve system as set forth in claim 7, wherein:

the system holding pressure mode is active during a hill start assist.

9. The valve system as set forth in claim 6, the control module further including:

a check valve adapted to fluidly communicate the braking demand control signal as the relay valve control pressure during an operator override mode.

10. The valve system as set forth in claim 1, wherein:

the tractor protection module delivers the pneumatic fluid at the control module delivery pressure when the trailer park brake pressure of the pneumatic fluid is set to an unparked state.

11. The valve system as set forth in claim 1, wherein:

the isolation check valve is a double-check valve delivering a higher of a first pneumatic reservoir pressure and a second pneumatic reservoir pressure as the supply pressure.

12. The valve system as set forth in claim 1, wherein:

the tractor protection module does not deliver the pneumatic fluid at the control module delivery pressure when the trailer park brake pressure of the pneumatic fluid is set to a parked state.

13. A valve system, including:

a first check valve including a first check valve pneumatic supply port and a first check valve pneumatic delivery port;

a second check valve including a second check valve pneumatic supply port and a second check valve pneumatic delivery port, the first check valve pneumatic delivery port

fluidly communicating with the second check valve pneumatic delivery port and a higher of respective pneumatic supply pressures of a pneumatic fluid at the first and second check valve pneumatic supply ports being fluidly transmitted to the first and second check valve pneumatic delivery ports as a pneumatic supply pressure of the pneumatic fluid;

a double-check valve delivering a braking demand pneumatic fluid control signal based on a higher of a first braking demand in a first pneumatic braking circuit and a second braking demand in a second pneumatic braking circuit;

a control module, including:

a pneumatic supply port fluidly communicating with both the first and second check valve pneumatic delivery ports and fluidly receiving the pneumatic supply pressure of the pneumatic fluid;

a pneumatic control port receiving the braking demand pneumatic fluid control signal; and

a pneumatic delivery port delivering a pneumatic fluid at a delivery pressure based on the braking demand pneumatic fluid control signal; and

a tractor protection valve including a tractor protection valve input port, fluidly communicating with the control module pneumatic delivery port, and a tractor protection valve output port, the pneumatic fluid at the delivery pressure from the control module pneumatic delivery port being delivered from the tractor protection valve input port to the tractor protection output port based on a state of the tractor protection valve.

14. The valve system as set forth in claim 13, wherein:

the state of the tractor protection valve is one of unparked and parked.

15. The valve system as set forth in claim 14, wherein:

if the state of the tractor protection valve is unparked, the pneumatic fluid at the delivery pressure from the control module pneumatic delivery port being delivered from the tractor protection valve input port to the tractor protection output port; and

if the state of the tractor protection valve is parked, the pneumatic fluid at the delivery pressure from the control module pneumatic delivery port not being delivered from the tractor protection valve input port to the tractor protection output port.

16. The valve system as set forth in claim 13, wherein the control module further includes a relay valve including:

a relay valve input port fluidly communicating with the control module pneumatic supply port for receiving the pneumatic supply pressure of the pneumatic fluid as a relay valve supply pressure of the pneumatic fluid;

a relay valve control port fluidly receiving a relay valve control pressure of the pneumatic fluid based on one of i) the braking demand control signal and the ii) control module supply pressure; and

a relay valve delivery port fluidly delivering a relay valve control pressure of the pneumatic fluid, based on the relay valve supply pressure and the relay valve control pressure, as the control module delivery pressure.

17. The valve system as set forth in claim 16, wherein the control module further includes:

a first control valve set to fluidly communicate the braking demand control signal as the relay valve control pressure based on a current braking mode; and

a second control valve set to fluidly communicate the control module supply pressure as the relay valve control pressure based on the current braking mode.

18. The valve system as set forth in claim 17, wherein:

the current braking mode is one of an operator controlled braking mode, a system increasing pressure mode, and a system holding pressure mode;

the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure, while the second control valve set to not fluidly communicate the control module supply pressure as the relay valve control pressure, if the current braking mode is the operator initiated braking mode;

the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure, while the first control valve is set to not fluidly communicate the braking demand control signal as the relay valve control pressure, if the current braking mode is the system increasing pressure mode; and

neither the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure nor the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure if the current braking mode is the system holding pressure mode.

19. The valve system as set forth in claim 18, wherein the control module further includes:

a check valve adapted to fluidly communicate the braking demand control signal as the relay valve control pressure during the system holding pressure mode.

20. A method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module, the method comprising:

delivering the pneumatic fluid from an isolation check valve at a supply pressure;

delivering a braking demand control signal of the pneumatic fluid, based on a higher of a first braking demand in a first pneumatic braking circuit and a second braking demand in a second pneumatic braking circuit, from a double-check valve;

receiving the supply pressure as a control module supply pressure of the pneumatic fluid;

receiving a control module control pressure of the pneumatic fluid based on the braking demand control signal;

delivering a control module delivery pressure of the pneumatic fluid based on the control module supply pressure and the control module control pressure; and

delivering the pneumatic fluid from the tractor protection module at the control module delivery pressure based on a trailer park brake pressure of the pneumatic fluid.

21. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 20, the step of delivering the pneumatic fluid from the tractor protection module at the control module delivery pressure based on the trailer park brake pressure of the pneumatic fluid including:

if the trailer park brake pressure is above a predetermined tractor protection supply pressure, delivering the pneumatic fluid at the control module delivery pressure from the tractor protection module.

22. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 20, the step of delivering the pneumatic fluid from the tractor protection module at the control module delivery pressure based on the trailer park brake pressure of the pneumatic fluid including:

if the trailer park brake pressure is in an unparked state, delivering the pneumatic fluid at the control module delivery pressure from the tractor protection module.

23. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 20, further including:

receiving a relay valve supply pressure of the pneumatic fluid based on the control module supply pressure;

receiving a relay valve control pressure of the pneumatic fluid based on one of i) the braking demand control signal and the ii) control module supply pressure; and

delivering a relay control pressure of the pneumatic fluid, based on the relay valve supply pressure and the relay valve control pressure, as the control module delivery pressure.

24. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 23, further including:

setting a first control valve to fluidly communicate the braking demand control signal as the relay valve control pressure based on a current braking mode; and

setting a second control valve to fluidly communicate the control module supply pressure as the relay valve control pressure based on the current braking mode.

25. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 24, further including:

setting the current braking mode to one of an operator controlled braking mode, a system increasing pressure mode, and a system holding pressure mode;

setting the first control valve to fluidly communicate the braking demand control signal as the relay valve control pressure, while the second control valve set to not fluidly communicate the control module supply pressure as the relay valve control pressure, if the current braking mode is the operator initiated braking mode;

setting the second control valve to fluidly communicate the control module supply pressure as the relay valve control pressure, while the first control valve is set to not fluidly communicate the braking demand control signal as the relay valve control pressure, if the current braking mode is the system increasing pressure mode; and

setting neither the first control valve to fluidly communicate the braking demand control signal as the relay valve control pressure nor the second control valve to fluidly communicate the control module supply pressure as the relay valve control pressure if the current braking mode is the system holding pressure mode.

26. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 25, further including:

fluidly communicating the braking demand control signal via a check valve as the relay valve control pressure during the system holding pressure mode.

27. The method for controlling a pressure of a pneumatic fluid delivered from a tractor protection module as set forth in claim 26, further including:

setting the mode as the system holding pressure mode during a hill start assist event.

28. A valve system, including:

an isolation check valve delivering pneumatic fluid as a supply pressure;

a tractor protection module delivering the pneumatic fluid at a tractor protection delivery pressure based on the supply pressure and a trailer park brake pressure of the pneumatic fluid; and

means for controlling the tractor protection delivery pressure.

29. The valve system as set forth in claim 28, further including a relay valve adapted to:

receive the supply pressure;

receive a relay valve control pressure of the pneumatic fluid based on one of i) a braking demand control signal and ii) the supply pressure; and

deliver a relay control pressure of the pneumatic fluid, based on the supply pressure and the relay valve control pressure to an input port of the tractor protection module.

30. The valve system as set forth in claim 29, further including:

a first control valve set to fluidly communicate the braking demand control signal as the relay valve control pressure based on a current braking mode; and

a second control valve set to fluidly communicate the supply pressure as the relay valve control pressure based on the current braking mode.

31. The valve system as set forth in claim 30, wherein:

the current braking mode is one of an operator controlled braking mode, a system increasing pressure mode, and a system holding pressure mode;

the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure, while the second control valve set to not fluidly communicate the control module supply pressure as the relay valve control pressure, if the current braking mode is the operator initiated braking mode;

the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure, while the first control valve is set to not fluidly communicate the braking demand control signal as the relay valve control pressure, if the current braking mode is the system increasing pressure mode; and

neither the first control valve is set to fluidly communicate the braking demand control signal as the relay valve control pressure nor the second control valve is set to fluidly communicate the control module supply pressure as the relay valve control pressure if the current braking mode is the system holding pressure mode.

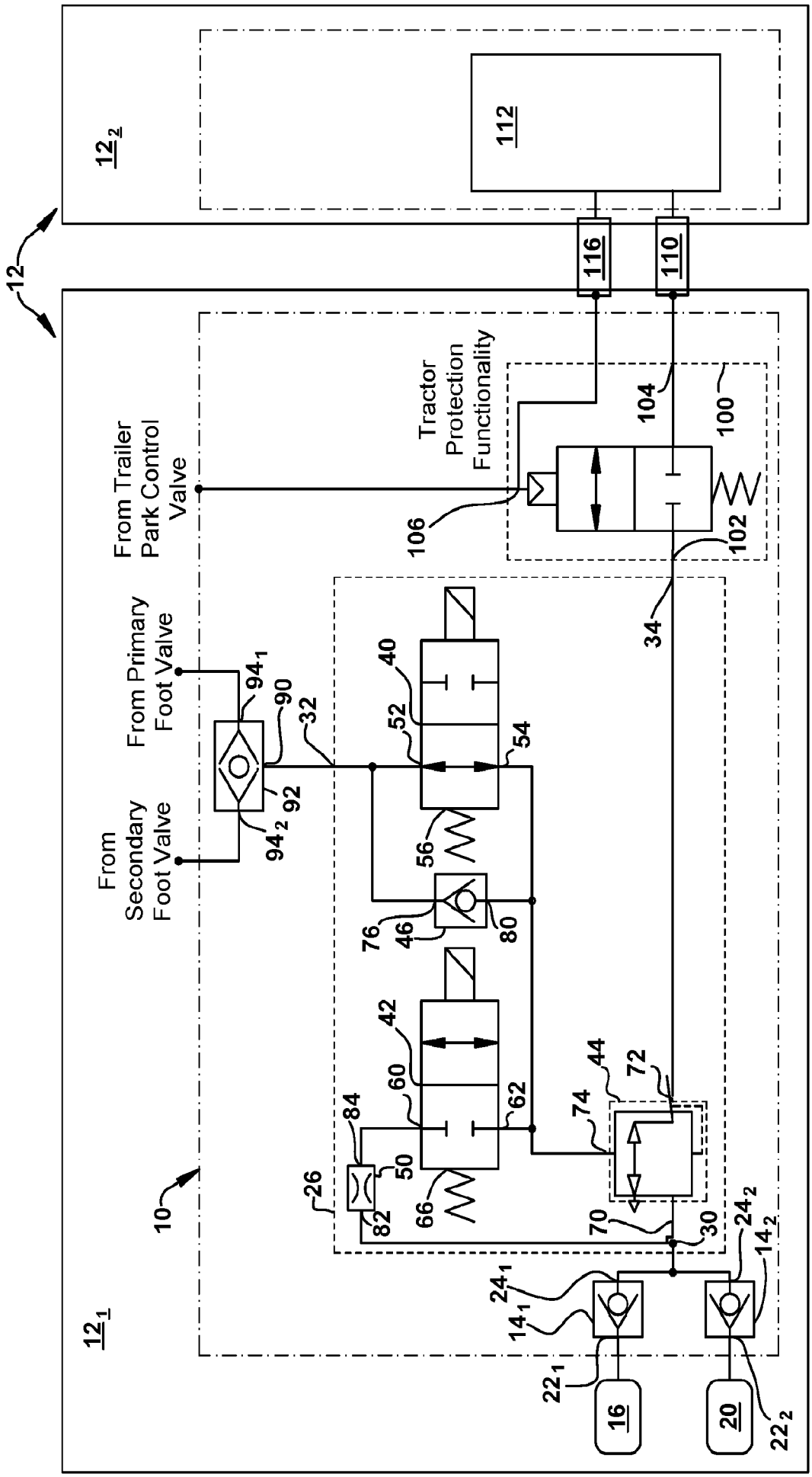

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From Trailer Park Control Valve
Tractor Protection Functionality
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94 1
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FIG. 1

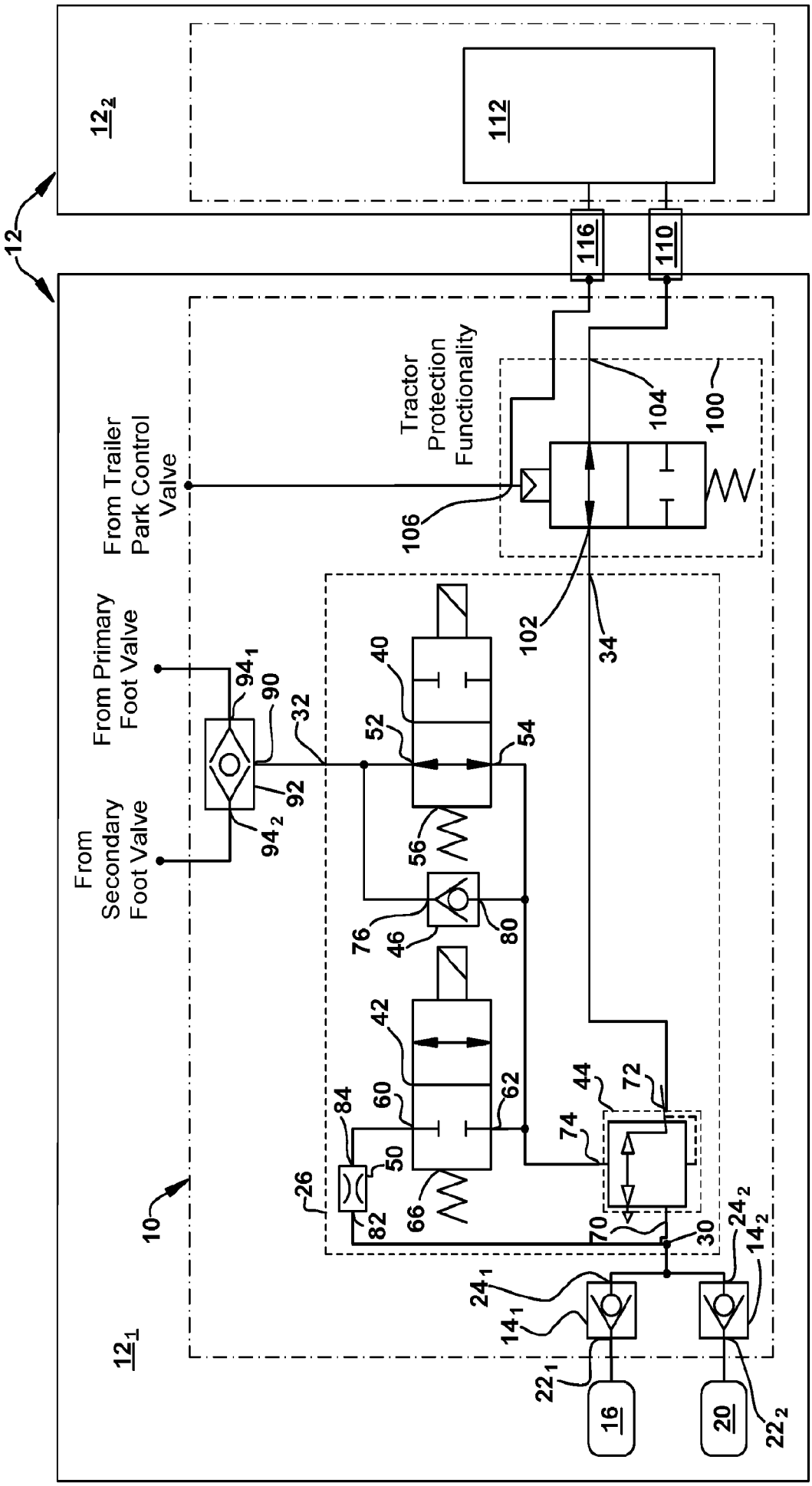

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FIG. 2

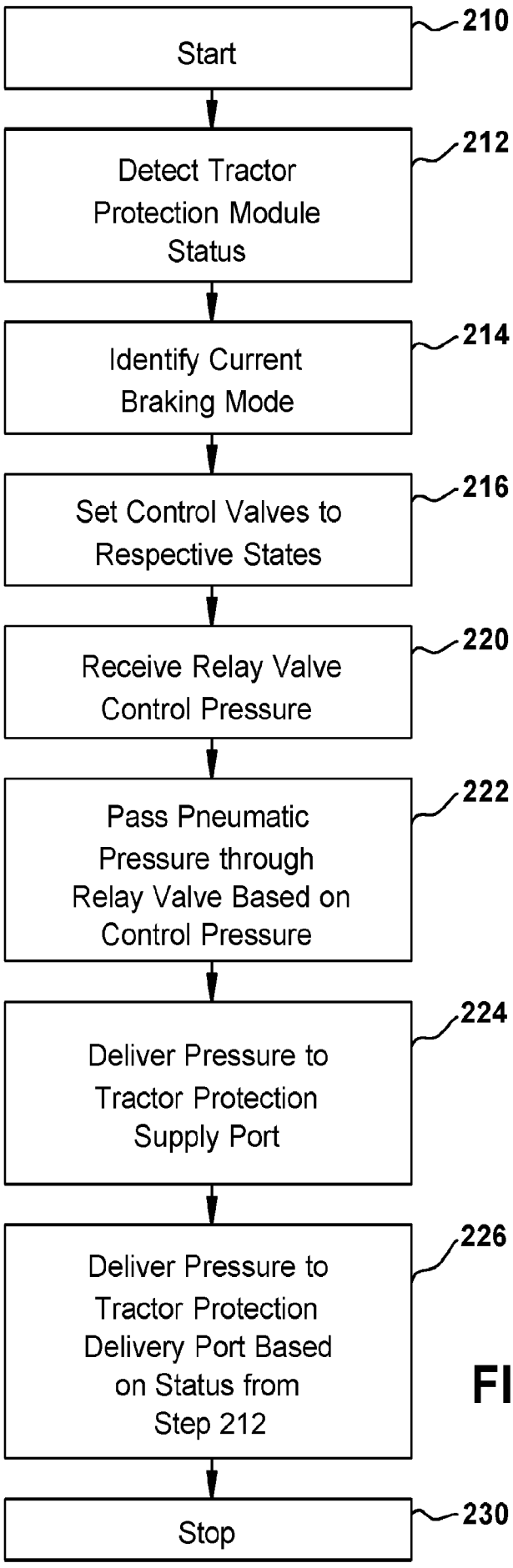

Start
210
Detect Tractor Protection Module Status
212
Identify Current Braking Mode
214
Set Control Valves to Respective States
216
Receive Relay Valve Control Pressure
220
Pass Pneumatic Pressure through Relay Valve Based on Control Pressure
222
Deliver Pressure to Tractor Protection Supply Port
224
Deliver Pressure to Tractor Protection Delivery Port Based on Status from Step 212
226
Stop
230

FIG. 3

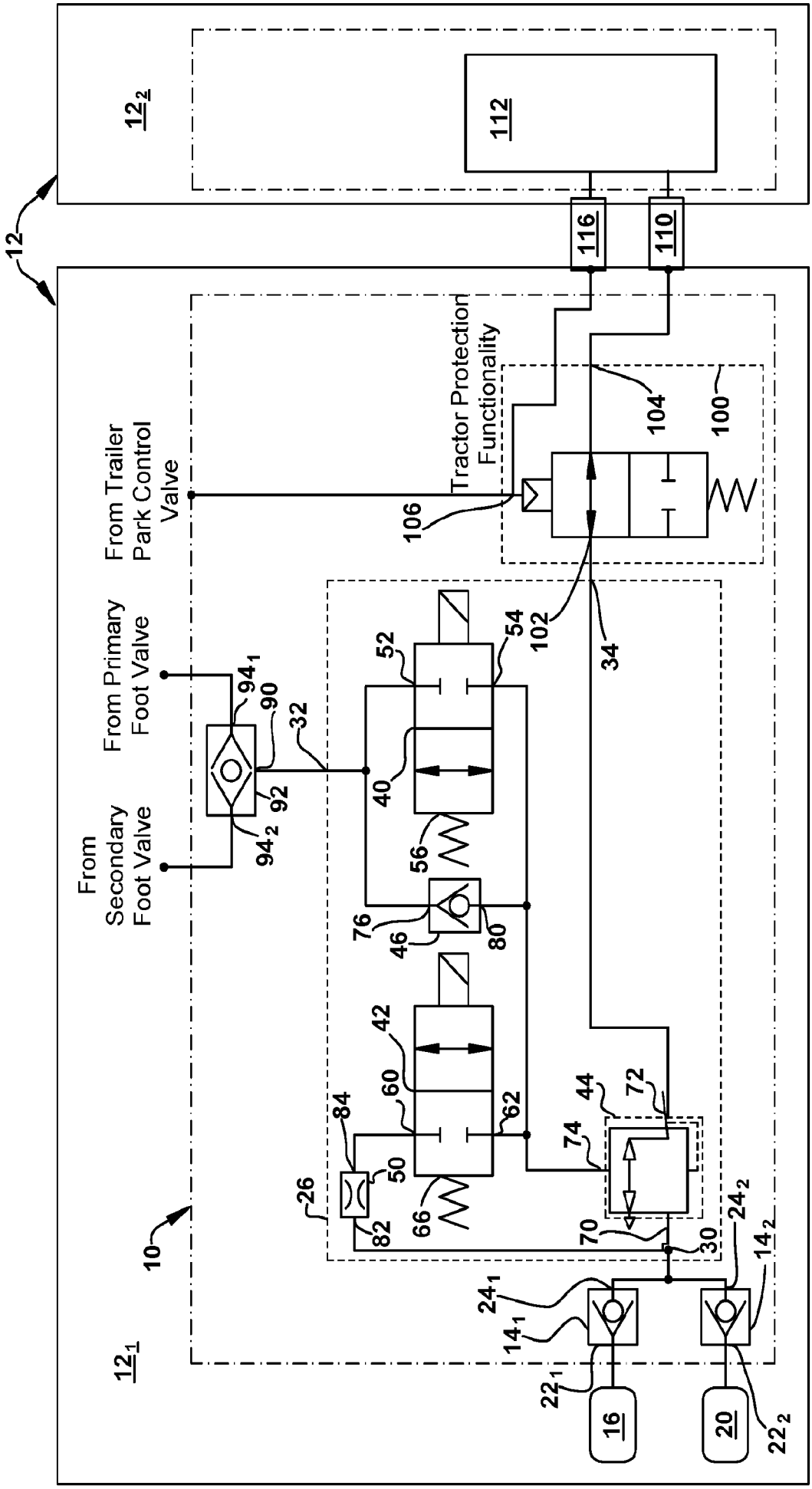

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FIG. 4

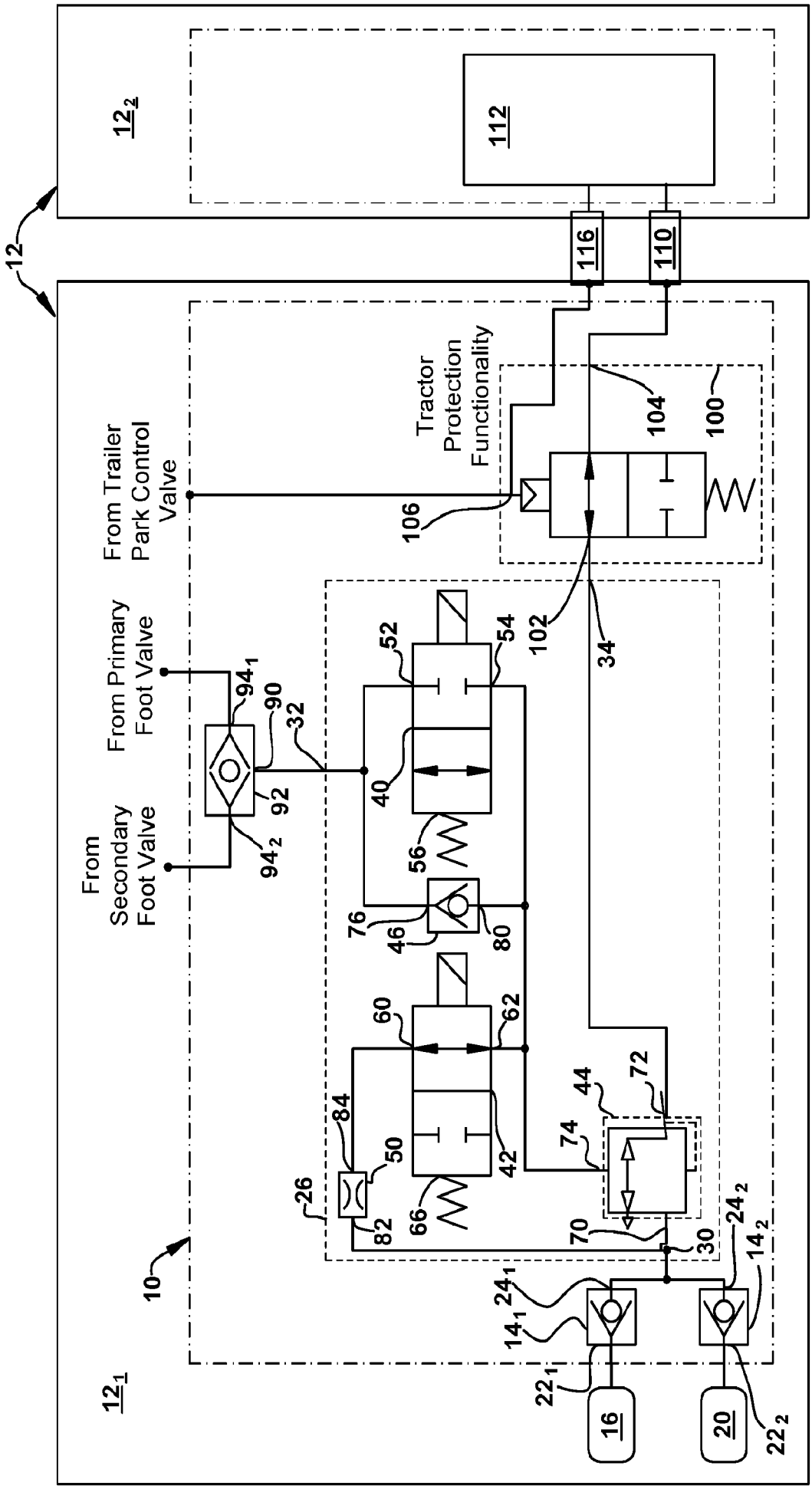

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FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/024532

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60T7/20 B60T15/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/258542 A1 (SOUPAL THOMAS R [US]) 23 October 2008 (2008-10-23)	1-4, 10-16, 20-23, 28,29
A	paragraphs [0020] - [0034]; figures 1-3	5-9, 17-19, 24-27, 30,31

A	DE 10 2006 041011 A1 (WABCO GMBH [DE]) 6 March 2008 (2008-03-06) paragraphs [0031] - [0056]; figure 1	1-31

A	DE 10 2006 041009 A1 (WABCO GMBH [DE]) 6 March 2008 (2008-03-06) paragraphs [0026] - [0040]; figure 1	1-31

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 July 2018	13/07/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Raffaelli, Leonardo

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/024532

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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1

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Information on patent family members

International application No
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		DE 102006041011 A1	06-03-2008
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		WO 2016177475 A1	10-11-2016