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AGRICULTURAL TRACTOR

TECHNICAL FIELD OF THE INVENTION

The present invention relates to an agricultural tractor including a hydraulical brake system and a pneumatical brake system for a trailer which can optionally be coupled to the tractor. To mention only a non-limiting example, the trailer may be a two-axle or multi-axle drawbar trailer.

Furthermore, the invention relates to a special pneumatical coupling head, which can especially be employed for an agricultural tractor of the above-explained kind, where via the pneumatical coupling head pressurised air can be transferred between trailer and tractor. If the pneumatical coupling head transfers pressurised air from the tractor to the trailer for providing a pressurised-air supply, the coupling head may be a so-called "coupling head supply". If the coupling head, however, transfers a pneumatical brake control pressure from the tractor to the trailer, the coupling head may be a so-called "coupling head brake".

PRIOR ART

The general configuration of a vehicle chain formed with a tractor and a trailer is known, for example, from EP 0 832 803 B1. The tractor is braked via a hydraulical brake system according to an actuation of a brake pedal. The tractor has a pneumatical brake system via which a pressurised air brake system of the trailer is supplied with pressurised air and wherein its actuation is controlled. For this purpose, the pneumatical brake system of the tractor has a compressor, which supplies a reservoir with pressurised air via a pressure regulator. The coupling head supply, via which the trailer is supplied with pressurised air, is connected directly to the reservoir. Between a coupling head brake and the reservoir, a trailer control valve is interposed. The trailer control valve dependent on actuation of the brake pedal by the driver and therefore dependent on the hydraulical pressure in the hydraulical brake system produces a pneumatical brake control pressure. For this purpose, the trailer control valve has two control ports for the two-circuit hydraulical brake system. The trailer control valve has an additional (not necessarily required) pneumatical control port, via which the brake control pressure can also be influenced

independently of the actuation of the brake pedal. Pressurising of the pneumatical control port is carried out dependent on a position of a parking brake lever, while several graduated control pressures according to the position of the parking brake lever can be induced.

DE 199 55 797 B4 discloses a tractor with a two-circuit hydraulical brake system, in which the hydraulical pressure in the circuits is registered via hydraulical pressure sensors. The signal of the hydraulical pressure sensors is fed to an electronic control arrangement. According to the hydraulical brake pressure measured, the electronic control arrangement then controls the electromagnetic valve devices, which are interposed between the reservoir and the coupling head supply and the coupling head brake to produce a pneumatical brake control pressure which corresponds to the hydraulical pressure. In a coupling head line for the brake control pressure, a pressure sensor senses the brake control pressure, which is then also fed to the control arrangement.

DE 10 2009 031 851 A1 refers to a generic agricultural tractor. The increasing use of continuous variable transmissions with hydrostatical-mechanical power split in agricultural tractors is described, which allow a continuous change of a transmission ratio without interruption of the transmission of power when set so by the driver via a so-called power control lever, an accelerator pedal or a joystick. By changing the transmission ratio and/or influencing the engine rotation speed, a braking of the tractor can be made possible, where for convenience actuation of the service brake via a brake pedal is often forgone. In such cases, neither the trailer of the tractor receives a brake light signal nor a brake effect at the trailer is achieved. This results in the trailer "running up" to the tractor or the trailer "pushing" the tractor, which may lead to a jack-knifing of the vehicle chain, to dangerous situations in traffic, to a loss of traction of the wheels of the tractor, heightened wear of the transmission, engine and wheels of the tractor and the like. DE 10 2009 031 851 A1 suggests to provide an electronic control device accordingly programmed in the tractor which actuates the brake system of the trailer even without actuation of the service brakes of the tractor, if the tractor is braked otherwise as explained. The programming of the control device is intended to be such that the shear or coupling force exerted on the tractor by the trailer is kept between a set threshold value. A characteristic value for the coupling force is, for example, to be derived from a difference or ratio of the actual engine rotation speed of the tractor and a set desired engine rotation speed, where these rotation speeds are especially provided by a CAN data bus. An automatic actuation of the brake system of the trailer through the control device can be limited to the tractor driving forward. Furthermore, it is suggested to make the strength of the

braking force of the trailer, which is set by the control device, dependent on the drive speed. Additionally, during the automatic actuation of the brake system of the trailer a brake light on the tractor and/or on the trailer can be activated automatically. Furthermore, a time limit for the automatic actuation of the brake system of the trailer to avoid overmuch strain on the brakes is possible. Additionally, automatic actuation of the brake system of the trailer for a standstill braking situation, i. e. while a standstill of the vehicle chain with idle parking brake is detected, is suggested in the publication.

According to DE 10 2008 048 208 A1, the pneumatical brake pressure of a trailer is on the one hand produced via a standard trailer control valve with a hydraulical-pneumatical brake circuit and on the other hand via an electro-pneumatical brake circuit. Generally, the production of the pneumatical brake control pressure is performed in the usual way via the trailer control valve. In selected areas of operation, for example within the responsive region of the hydraulical brake circuit with a hydraulical brake pressure below a response pressure, however, the electro-pneumatical brake circuit can be given preference via a control unit, in that the production of the pneumatical brake control pressure in the hydraulical-pneumatical brake circuit is "bridged" via the trailer control valve and the pneumatical brake control valve is controlled only via the electro-pneumatical brake circuit. Control of the pneumatical brake control pressure via the electro-pneumatical brake circuit is achieved through a control unit, which controls electro-pneumatical valves, for example based on a measurement signal of the pedal displacement of the brake pedal or a measured hydraulical pressure.

DE 10 2009 045 191 A1 discloses a trailer control valve in which a first piston area is pressurised with the hydraulical brake pressure, while a second piston area is pressurised with a pneumatical pressure. Even before the response pressure is reached, via the pneumatical pressure on the second piston area the response characteristics of the pneumatical brake system for the trailer can be influenced. Furthermore, it is suggested that even during driving operation the amount of biasing of the second piston area with the pneumatical pressure is controlled dependent on driving operation conditions, which regards for example the duration, time pattern and absolute value of the pressurising by the pneumatical pressure.

DE 10 2005 042 673 A1, DE 42 30 674 A1 and DE 199 55 798 A1 describe the sensing of the pressure in a supply line to a coupling head via an electro-pneumatical sensor. Recognising whether the coupling head is connected to a counter coupling head in this case is made possible

by elaborate testing and analysis procedures, as these are for example described in detail in DE 199 55 798 A1.

An agricultural tractor with a hydraulical brake system and a pneumatical brake system for a trailer that can be coupled with the tractor is known from species-defining DE 88 07 872 U1.

DE 10 2010 038 766 A1 discloses the recording of the coupling state of a coupling head via electromechanical contact elements.

OBJECT OF THE INVENTION

It is the object of the invention to improve an agricultural tractor with respect to the options for considering whether the tractor is coupled with a trailer or not. This improvement especially regards an improvement of

- the drive characteristics,
- the brake characteristics,
- the driving stability,
- the coupling force and/or the driving dynamics.

Furthermore, it is the object of the invention to suggest a pneumatical coupling head with extended functionalities.

SOLUTION

According to the present invention, the object of the invention is solved by the features of the independent claims. Additional preferred embodiments according to the invention are to be seen in the dependent claims.

DESCRIPTION OF THE INVENTION

The present invention is based on the finding that the characteristics of a tractor in use significantly change dependent on whether the tractor is coupled with a trailer or not. To mention only a few examples, the drive aggregate of the tractor is dimensioned in such a way with regard

to its power that the tractor can also pull a fully-loaded trailer. Without the trailer, the tractor therefore has surplus power, which can lead to a slipping of the driven wheels during acceleration processes. A speed with which the tractor can move through a curve without losing traction, without oversteering or understeering and without tipping can be dependent on whether a trailer is coupled to the tractor or not. For this reason an automatic detection of whether a trailer is coupled to the tractor can be of interest.

Coupling sensors are known which are placed in the mechanical flow of forces between the tractor and trailer. Such coupling sensors can be triggered by the coupling and decoupling of a tractor and trailer by mechanical biasing in the flow of forces between tractor and trailer. It is also possible that a coupling sensor senses a coupling force, i. e. a drag force or shearing force between trailer and tractor. However, such coupling sensors arranged in the mechanical flow of forces are very expensive. Furthermore, the coupling sensors have to be able to be used in the rough conditions during establishing and loosening the mechanical coupling, so that these have to be robust. Finally, they need to be able to absorb high coupling forces if they are arranged directly in the flow of forces between the tractor and trailer.

According to the invention, a coupling sensor employed in the mechanical flow of forces for transfer of the coupling forces between tractor and trailer is surprisingly not employed. Rather, a sensing of the coupling state is performed independently of (and possibly also spatially separated from) this mechanical coupling in the region of a pneumatical coupling head, where via the pneumatical coupling head pressurised air is transferred between the tractor and the trailer when the counter coupling head of the trailer is coupled to the coupling head. This can especially be the coupling head brake and/or the coupling head supply.

The invention suggests to integrate a valve into the coupling head. Apart from the coupling head line present in the coupling head anyway, the coupling head also has a branching line. The valve mentioned is interposed between the coupling head line and the branching line. When the counter coupling head is coupled to the coupling head, that is when the pneumatical connection between tractor and trailer is established - which is usually only done after mechanical coupling of the trailer to the tractor - the valve is automatically brought into an open position, in which the coupling head line is pneumatically connected to the branching line. Therefore, only with the coupling of the counter coupling head to the coupling head with integrated valve, the branching line is pressurised with the pressure in the coupling head line. Therefore, ultimately the pressure

conditions in the branching line are dependent on whether the coupling head is coupled to the counter coupling head or not, i. e. whether the trailer and the tractor are pneumatically connected or not.

According to the invention and considering this background, it is suggested that a sensor senses the pressure in the branching line, so that an electrical pressure signal is present which is dependent on whether the counter coupling head is coupled to the coupling head or not. In effect, therefore the electrical output signal of the sensor provides information about whether the tractor is coupled pneumatically with the trailer or not.

The present invention modifies a coupling head with integrated valve which is known in the installation manual 355 026 for the product "G 819", that is, a trailer control valve, according to the December 1982 edition from the company of the legal predecessor of the applicant. In this installation manual an installation example is described for a utility vehicle in which supply pressurised air is fed to a coupling head line of a coupling head supply from an outlet port 21 of the trailer control valve. The coupling head has an integrated tilt valve which is in a closed position when no trailer is pneumatically coupled. When the trailer is coupled, the tilt valve is tilted into its open position, resulting in the tilt valve connecting the coupling head line with a branching line. The branching line is pneumatically led back to the trailer control valve. The pressurised air thus led back via the branching line therefore can change the pressure conditions on the trailer brake valve and its operating position dependent on whether the trailer is coupled to the tractor, that is, pneumatically trigger the trailer control valve.

In deviation to this, the invention suggests using a link of a coupling head line to a branching line via a valve, the switching position of which is dependent on whether a counter coupling head is coupled to the coupling head, in combination with an electrical sensor, so that according to the invention a new "electrical coupling sensor" is formed. This coupling sensor produces an electrical signal which can be used in a number of ways and can be transmitted in a simple way via an electrical line, for example a CAN bus. It is also advantageous that the "coupling sensor" formed in this way can be placed distant from the mechanical coupling between tractor and trailer. The embodiment according to the invention is only a minor modification of a coupling head in itself known, which however reliably senses the coupling state between tractor and trailer and produces an electrical signal correlated to the coupling state.

Without this having necessarily to be the case, in a preferred embodiment of the invention the branching line is deaerated without a coupled counter coupling head. Deaerating can also be achieved by the valve integrated into the coupling head. For example, deaerating of the branching line is done through a valve body of the integrated valve and/or the deaerating is done through an outlet opening of the valve which is used for the pneumatical connection between coupling head and counter coupling head when the counter coupling head is connected.

It is also possible that within the frame of the present invention the electrical output signal of the sensor is exclusively used to determine whether the trailer is coupled to the tractor or not. It is also possible, however, that possibly after it has been detected that the trailer is coupled to the tractor a kind of pressure monitoring in the branching line and therefore on the coupling head is achieved via the sensor. If, for example, the coupling head is a coupling head supply, a loss of pressure can be seen as an indication for a high use of pressurised air occuring in the region of the trailer, so that a conveying mode of the compressor has to be initiated or the conveying performance of the compressor is raised. It is also possible that on the basis of a loss of pressure it is detected if there is a leakage in the region of the supply line and/or if the supply line is torn off. If, on the contrary, the coupling head is a coupling head brake, via the sensor the brake control pressure can be monitored, in which way possibly a control of the brake control pressure is possible or a defect in the lines can be discovered. For the embodiments mentioned, therefore the sensor can be used multifunctionally.

It is possible that the electrical signal generated by the sensor is used in a user-defined way. To mention only an example, the electrical signal, especially when accordingly amplified, can be fed directly to an actuator, valve or similar, so that due to the electrical signal an operating state of a construction element of the agricultural tractor may be changed. For a preferred embodiment of the invention, however, the electrical signal produced by the sensor is fed to a control unit. As such a control unit a signal central control unit is understood or a cooperation of several control unit modules, which may be arranged in a distributed way on the vehicle and which may serve for the same or different purposes. It is possible that the combination of several control unit modules or the feeding of the electrical signal to a control unit is achieved through a CAN bus system. Using the control unit, then the electrical signal may be used and analysed in a variety of ways, for example for detecting whether the trailer is coupled to the tractor, for monitoring the pressure, to be able to discern a leakage or a tear-off in the supply line or to be able to perform a monitoring or a controlling of the brake control pressure. With the control unit, dependent on the

result of the analysis different measures may be triggered. To mention only a simple example, when it is registered that the trailer is pneumatically coupled to the tractor, a correspondent information can be displayed to the driver in the driver's cabin, for example with a "trailer pneumatically coupled" light.

The construction elements of the agricultural tractor and the coupling head mentioned can be realised at will as singular construction elements, as modules flanged to each other or as construction elements integrated into a common housing. For a special suggestion of the invention, with the coupling head, the valve and the sensor a construction unit is formed. In the simplest case the construction unit is connected to further construction elements only via

- a mechanical attachment to the tractor,
- the outlet opening for handover to the counter coupling head of the trailer,
- a pneumatical port for the connection of the coupling head line with the pressurised air supply and
- an electrical port, through which the output signal of the sensor is led away.

This construction unit can be marketable separately and be mounted to the agricultural tractor as a whole. In the common housing then also the necessary construction elements, especially the valve and the sensor, may be placed protected from mechanical damages and contamination.

For an alternative embodiment, the coupling head and the valve form a construction unit, while the sensor is placed spatially distant from the construction unit. The connection of the sensor and the construction unit is then achieved via the branching line and a pneumatical line connected to it, which extends from the coupling head.

Generally, the valve can be formed in any way, for example also as a slide valve. The number of positions and port of the valve basically also can be chosen in any way, given that a defined pneumatical state of the valve is achieved when the coupling head is coupled to the counter coupling head. For a special embodiment of the invention the valve is realised as a seated valve. In this case the valve has a valve body which is pressed against a valve seat by a spring when the counter coupling head is not coupled to the coupling head, in which way the closed position between the coupling head line and the branching line is provided. When the counter coupling head is coupled to the coupling head, the valve body is moved away from the valve seat by a

contact element, which entails biasing of the spring. Preferably, in this way therefore the movement of the valve body is achieved in a motion-controlled way with achieving the connection between the counter coupling head and the coupling head. The contact element, through which the actuation of the seated valve is achieved, can be formed with a slide which acts upon the valve body. It is also possible that the contact element is an integral part of the valve body.

Further aspects of the invention deal with the options of influencing the agricultural tractor dependent on the signal produced by the sensor, that is, dependent on whether the tractor is coupled to the trailer or not or whether the branching line is pressurised or not.

For a first embodiment the control unit has control logic, which influences a drive power, a brake power, a driving stability control, a coupling force and/or a driving dynamic control of the tractor dependent on the signal produced by the sensor. To mention only some non-limiting examples, dependent on the signal produced by the sensor an influencing of the motor management of the drive aggregate can be achieved. It is possible that dependent on the signal produced by the sensor different characteristic curves between a power preset by the driver, especially a pedal angle and the power demand on the drive aggregate, for example a throttle valve angle can be used. It is also possible that power is limited when the signal produced by the sensor indicates that no trailer is coupled to the tractor. It is also possible that for a signal produced by the sensor, which indicates that the trailer is coupled to the tractor, the maximum speed of the tractor with the trailer is limited.

In a further embodiment of the invention the control unit has control logic which influences the operating state of a transmission dependent on the signal produced by the sensor. For example, when it is detected that the tractor is coupled with the trailer so that a higher load has to be pulled, in the transmission automatically a lower gear transmission ratio or a different transmission characteristic curve can be chosen to account for the higher mass to be accelerated.

The invention suggests as another option that the control unit is equipped with control logic which senses braking of the tractor without actuation of the service brakes of the tractor. If at the same time a signal of the sensor is present which indicates that a trailer is coupled to the tractor, then a trailer control valve is controlled in such a way that it produces a pneumatical brake control pressure for the trailer. In this way, a running-up of the trailer can be avoided or reduced if due to a pushing operation of the power train of the tractor a braking of the tractor is achieved without

the service brakes of the tractor being actuated. This simplifies the use by the driver because the driver can to a limited extent cause braking for example through the joystick or by lifting pressure on the acceleration pedal. On the other hand, through the procedure according to the invention in such a braking operation the braking load is spread evenly over the wheels of the tractor and the wheels of the trailer via the power train of the tractor. Preferably, in the case explained the trailer control valve is controlled in an electrical or electromagnetic way of control in which a brake control pressure of the trailer control valve is controlled which is dependent on the brake effect which is caused by using the power train in pushing operation.

In a special embodiment of this inventive idea the detection that the tractor is being braked without actuation of the service brake of the tractor is performed dependent on the position of a joystick actuated by the driver. For example, a sensor can sense the position of the joystick - if the driver actuates the joystick in a braking region, dependent on the position of the joystick an output signal of the sensor assigned to the joystick can be used for control of the pneumatical brake control pressure for the trailer, possibly by interposing the trailer control valve which then is electrically controlled.

It is possible that an electrical interface between tractor and trailer is present. If this is used to transfer a brake light signal for a braking process to the trailer so that a trailer brake light is actuated according to necessity, usually the electric brake light signal in the tractor is produced independently of whether a trailer is indeed coupled or not. According to the invention, the control unit can be equipped with control logic which dependent on the signal produced by the sensor produces an electrical brake light signal for the trailer so that this is only produced and an electric power intake only occurs when the brake light signal can indeed be taken up and used for a coupled trailer.

In a further embodiment of the invention the control unit has control logic which also executes trailer control, which for example may be achieved by interaction with an (also) electromagnetically actuated trailer control valve. According to the invention, the trailer control is done in dependence on the signal produced by the sensor. In the simplest case this dependency is that depending on whether the trailer is coupled or not the trailer control valve may be activated or deactivated. It is also possible that the controlled brake control pressure may be led back via the signal produced by the sensor in order to be able to monitor or control the brake control pressure.

In a further embodiment of the invention the control unit has control logic which limits speed dependent on the signal produced by the sensor. For example the dependency is that a speed limit is only enforced when the signal indicates that a trailer is coupled. It is also possible that in this case a speed limit present without the trailer is modified to a smaller speed. To mention only an example, a speed limit of 25 km/h can be activated if it is recognised that the coupling head is coupled to a counter coupling head, that is, a trailer is coupled to the tractor.

In a further embodiment of the invention the control unit has control logic which determines a switching position of an "offroad" switch of the tractor. The control unit performs an automatic modification of a brake force of the trailer and/or the tractor dependent on the switching position of the offroad switch and dependent on the signal produced by the sensor. It is for example possible that an automatic actuation of the pneumatical brakes of the trailer is not allowed if the service brakes of the tractor are not actuated by the driver. This is only true for use in road traffic, while in an offroad mode automated brake action for the trailer is permitted. In this case, using the control unit, it is first detected whether the offroad switch is actuated. If this is the case and therefore automatic brake action for the trailer is allowed, for example an automatic brake action on the trailer can be executed when the tractor is braked via the joystick and a signal of the sensor which indicates that the trailer is coupled, for example by suitable electrical control of a trailer control valve.

It is also possible that the control unit has a control logic which dependent on the signal produced by the sensor activates a stretching brake function. This function has the aim to avoid a possible shearing force of the trailer to the tractor - the stretching brake function rather guarantees that the brake force of the trailer is increased in such a way and/or the brake force of the tractor decreased in such a way that the acceleration of the trailer without coupling to the tractor would be slightly smaller than that of the tractor. In this way in the mechanical coupling between the tractor and the trailer in any case a drag force is produced, which keeps the vehicle chain with the tractor and the trailer straight. This has a positive influence on the driving stability of the vehicle chain. If the signal of the sensor signalises that no trailer is coupled to the tractor, the stretching brake function may be deactivated so that the full braking force is caused on the tractor and/or no possible other pneumatical brake force is caused on the trailer or decreased.

In a further embodiment of the invention the control unit has control logic, which dependent on the signal produced by the sensor performs an estimate of a coupling force between tractor and

trailer. Only in the case that the signal produced by the sensor indicates that a trailer is coupled to the tractor, a suitable algorithm for estimating the coupling force may be executed. To mention only a non-limiting example for an algorithm for estimating the coupling force, reference is made to the algorithm according to DE 10 2009 031 851 A1, which is based on a comparison of a desired engine speed with an actual engine speed.

In a further embodiment of the invention a coupling force estimated in such a way is used according to the invention to influence a drive power, a brake force of the tractor, a brake force of the trailer, a driving stability control and/or a driving dynamic control of the tractor. In the simplest case, an influence can be such that the estimated coupling force is adapted to a set coupling force or a coupling force progress, for example a disappearing coupling force or a set stretching coupling force.

It is possible that the valve which is interposed between the coupling head line and the branching line only serves for a control of the pressure biasing of the branching line, so that a further valve is present which is interposed between the coupling head line and an outlet opening of the coupling head. For an extension of the invention, however, the valve is multifunctional in that it controls the pressurising of the branching line as well as it is interposed between the coupling head line and the outlet opening.

A further solution of the object of the invention is given by a special embodiment of a pneumatical coupling head which is employed within the frame of the coupling of a tractor with a trailer and which therefore can be allocated to the tractor or the trailer. This can be a coupling head supply and/or a coupling head brake, where it is also possible that it is a combined coupling head. It is also possible that it is a coupling head as it is described in the not pre-published patent application DE 10 2012 100 402.1 of the applicant, with which selectively either the coupling between tractor and trailer via pneumatical ports on the one hand and electrical ports via a so-called EPI module on the other hand may be provided.

In a coupling head according to the invention a valve of any construction may be integrated which has a valve body. The valve body has a closed position in which the coupling head is sealed from the environment. This closed position is preferably employed when the coupling head is not connected to the counter coupling head. In the closed position the valve then prevents an undesired discharge of pressurised air from the coupling head line into the environment.

Further to that, the valve body has an open position, in which the coupling head is pneumatically connected to a counter coupling head, in which way especially pressurised air from the coupling head line may pass over to a suitable port or a line of the counter coupling head, to transfer for example a brake control pressure and/or a supply pressure from the coupling head to the counter coupling head.

According to the invention, the valve body is brought from the open position to the closed position automatically with the coupling of the coupling head to the counter coupling head (and brought from the open position to the closed position when the decoupling of the coupling head from the counter coupling head is performed). A sensor senses the position of the valve body of the valve integrated into the coupling head, in which way the sensor in the end senses whether the coupling head is coupled to a counter coupling head.

For an embodiment of this basic thought, the sensor is a displacement sensor which directly senses the position of the valve body. It is also possible that the displacement sensor only indirectly senses a position of the valve body by sensing the position of a further element the position of which is dependent on the position of the valve body.

In a further embodiment, the sensor is a pressure sensor which senses the position of the valve body only indirectly by sensing a pressure dependent on the position of the valve body.

In a special embodiment of this solution strategy, the valve is interposed between a coupling head line and a branching line. In the closed position of the valve body, the coupling head line is pneumatically separated from the branching line, where the branching line is deaerated. In the open position of the valve body, on the contrary, the coupling head line is pneumatically coupled to the branching line. The pressure difference of the branching line deaerated in the closed position and the branching line pressurised with the pressure in the coupling head line in the open position can then be used for determining whether the coupling head is coupled to a counter coupling head. In order to do this, the pressure sensor senses the pressure in the branching line.

Aside from monitoring the coupling state, the pressure signal of the pressure sensor in the branching line can be used multifunctionally, by monitoring the pressure in the supply line and/or the brake control line for coupling of the coupling head to the counter coupling head, so that for example an automatic detection of a defect such as a leakage in the supply line or brake control

line can be done. It is also possible that based on the pressure sensed with the pressure sensor a pressure control for e. g. the brake control pressure for the trailer is provided.

Generally, the invention also includes a coupling head in the broader sense, in which the sensor, especially the pressure sensor, is placed decentrally from the base body of the coupling head. In a special embodiment of the invention, however, a construction unit is formed with the coupling head, the valve and the sensor.

The sensor employed within the frame of the invention can be realised as an analogue or digital sensor. It is also possible that the sensor in the simplest case is realised as a switch which has only two switching positions and where the sensor takes on a first switching position when the coupling head is not coupled to the counter coupling head and the second switching position when the coupling is achieved. Therefore, the switch can switch at a threshold value, which guarantees that the coupling has been achieved.

According to the invention, in the branching line there are two wholly different pressure states:

- In the closed position of the valve integrated into the coupling head, the branching line and the coupling head line are separated. Therefore, the sensor in this switching state of the valve does not sense the pressure in the coupling head line, but another pressure. For the embodiment shown, in this switching state the branching line is deaerated.

- The sensor, on the contrary, at coupling of the counter coupling head and bringing the valve into the open position measures the pressure in the coupling head line, therefore a qualitatively different pressure. The detection whether coupling has been achieved according to the invention is possible in an especially simple way. It is even possible that only a binary pressure switch is employed, which dependably detects whether the coupling of the coupling head with the counter coupling head is achieved. In order to do this, the pressure switch (or any other pressure sensor) only needs to be able to differentiate between a pressure difference for the deaerated branching line on the one hand and for the branching line pressurised from the coupling head line on the other hand.

Advantageous developments of the invention result from the claims, the description and the drawings. The advantages of features and of combinations of a plurality of features mentioned at

the beginning of the description only serve as examples and may be used alternatively or cumulatively without the necessity of embodiments according to the invention having to obtain these advantages. Without changing the scope of protection as defined by the enclosed claims, the following applies with respect to the disclosure of the original application and the patent: further features may be taken from the drawings, in particular from the illustrated designs and the dimensions of a plurality of components with respect to one another as well as from their relative arrangement and their operative connection. The combination of features of different embodiments of the invention or of features of different claims independent of the chosen references of the claims is also possible, and it is motivated herewith. This also relates to features which are illustrated in separate drawings, or which are mentioned when describing them. These features may also be combined with features of different claims. Furthermore, it is possible that further embodiments of the invention do not have the features mentioned in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention is further explained and described with respect to preferred exemplary embodiments illustrated in the drawings.

Fig. 1 in a schematic vertical sectional view shows a coupling head with a valve between a coupling head line and a branching line.

Fig. 2 shows a construction unit with a coupling head according to Fig. 1 and an additional sensor for sensing the pressure in the branching line.

Figs. 3 to 7 schematically show a tractor with a hydraulical brake system and a pneumatical brake system with a trailer control valve and coupling head according to Fig. 1.

Fig. 8 in a schematic vertical sectional view shows a coupling head with a displacement sensor which senses a position of a valve body of a valve.

DESCRIPTION OF THE DRAWINGS

In **Fig. 1**, a coupling head 1 is schematically shown. Coupling heads as such have been known for many years from various prior art, see for example AT 376619 B, DE 34 25 113 A1, DE 36 07

137 A1, DE 199 31 162 A1, DE 296 03 481 U1, DE 10 2009 036 619 A1 and WO 2011/042455 A1. These known embodiments have additional functions such as for example an integrated filter which can also be integrated into embodiments according to the invention. In Fig. 1, the illustration is reduced to aspects which have a connection to the present invention. While in the figures only the coupling head 1 associated with the tractor is shown, but not the counter coupling head associated with the trailer, from the documents mentioned options for the coupling or connection of the coupling head 1 with the counter coupling head can also be taken.

The coupling head 1 has a base body 2 which via a fixing element 3 not shown in detail is mounted to the tractor. The coupling head 1 has a port 4 for a coupling head line 5 extending inside the coupling head 1 and a port 6 for a branching line 7 extending in the interior of the coupling head 1. The coupling head line 5 and the branching line 7 are realised especially with blind bores oriented in the direction of the vehicle longitudinal axis and ending in the ports 4, 6.

The coupling head 1 has a connecting region 8 in the region where the coupling head 1 can be coupled mechanically to the counter coupling head of the trailer. Preferably, the connecting region 8 of the coupling head 1 and a corresponding connecting region of the counter coupling head of the trailer form a kind of bayonet joint. From the connecting region 8, a valve body 9 extends in the upwards direction, which for reasons of manufacture and assembly is realised with two base body parts 10, 11. A valve seat 12 realised by the base body 2 together with the valve body 9 forms a valve 13. In the closed position active in Fig. 1, the valve 13 closes the connection of the coupling head line 5 to the branching line 7 and the connection of the coupling head line 5 with an outlet opening 14 of the coupling head 1, through which the pressurised air from the coupling head line 5 for the coupled counter coupling head is transferred to the trailer. The branching line 7 is permanently connected to an outlet opening 14 of the coupling head 1 independently of the valve position of the valve 13. In the closed position of the coupling head 1 active in Fig. 1, in which the latter is not coupled to the counter coupling head, the branching line 7 is therefore deaerated via the outlet opening 14.

The coupling head line 5 ends in a coupling head chamber 15. The coupling head chamber 15 is connected to the branching line 7 via a guidance bore 16. In the guidance bore 16, the valve body part 11 is axially and glidingly guided in a vertical direction. A pneumatical sealing is achieved via a sealing element 17, here a sealing ring, which is active between an outer surface of the valve body part 11 and the guidance bore 16. The valve body part 11 in a first approximation in the

longitudinal sectional view shown is T-shaped with a vertical arm 18, which has a through bore 19 and a horizontal arm 20 which is penetrated by the through bore 19 and radially to the outside on a circumferential collar 21 has a valve seal 22. By a pressure spring 23, one spring base of which is supported on a floor of the coupling head chamber 15 and the other spring base of which is supported on the underside of the horizontal arm 20, the valve body part 11 and the valve seal 22 in the closed position of the valve 13 are pressed against the valve seat 12 formed by the base body 2.

In a half-longitudinal section the valve body part 10 is roughly approximately realised in the shape of an upside-down U with a horizontal base arm 24 and two parallel vertical side arms 25, 26. The radially inside side arm 26 is realised longer than the radially outside side arm 25. The front face of the side arm 26 facing away from the base arm 24 is supported radially to the inside on the valve seal 22 on the upper side of the horizontal arm 20 of the valve body part 11. The radially outside side arm 25 in the end region facing away from the base arm 24 has a thickening 27. In the region of the thickening 27 the valve body part 10 is guided in a guidance bore 28 of the valve body 2 and is sealed by a sealing element 29, here a sealing ring. The circumferential side arm 26 radially on the inside limits a through bore 30, which opens out into the through bore 19, in which way a permanent connection of the outlet opening 14 with the branching line 7 is provided. In the closed position shown in Fig. 1, the thickening 27 is pressed against a shoulder 31 protruding radially to the inside. A double fit due to the pressing of the thickening 27 to the shoulder 31 on the one hand and the closed position of the valve 13 on the other hand is avoided by the elasticity of the valve seal 22.

The function of the coupling head is as follows:

a) In the coupled state not shown in Fig. 1, the valve body 9 as shown protrudes upwards from the coupling head 1. The thickening 27 is pressed against the shoulder 31. The valve body 9 with the valve seal 22 is pressed against the valve seat 12 by the pressure spring 23, so that the valve 13 is closed.

b) If the counter coupling head is coupled to the coupling head 1, a counter contact element of the counter coupling head is brought into contact with a contact surface 32, which is formed by the upper side of the base arm 24 of the valve body part 10. The valve body 9 is pressed downwards by a contact force in the contact surface 32, for example by closing

the bayonet connection between the coupling head 1 and the counter coupling head, in which way the valve body 9 with the two valve body parts 10, 11 moves downwards. Therefore, the thickening 27 moves away from the shoulder 31. At the same time, the valve seal 22 separates from the valve seat 12, until the valve 13 is opened. In this open position, pressurised air from the port 4 through the coupling head line 5 and the open valve 13 can pass into the through bore 30 via a radially oriented through hole 33 of the valve body part 10, so that the pressurised air can reach the branching line 7 on the one hand and the outlet opening 14 on the other hand, from where it then can pass to the counter coupling head and eventually the pressurised air system of the trailer.

So, for the embodiment according to the invention the valve 13 is multifunctional, by enabling a transfer of pressurised air from the port 4 and the coupling head line 5 to the outlet opening 14 only if a counter coupling head is connected to the coupling head 1 and on the other hand by only establishing an pneumatical connection between the coupling head line 5 and the branching line 7 under the same condition. The pressure in the branching line 7 and on the port 6 therefore indicates whether a counter coupling head is connected with the coupling head 1. If no counter coupling head is connected with the coupling head 1, the branching line 7 according to Fig. 1 is deaerated. If, on the contrary, a counter coupling head is connected to the coupling head 1, the pressure in the branching line 7 is equal to the pressure on the coupling head line 5, therefore for example a pressure in a supply reservoir of the tractor.

It is possible that a sensor 34 is connected to the port 6 via a line of any length and in any position on the tractor, to sense the pressure in the branching line 7. In this case, the coupling head 1 forms a construction unit 35 with the valve 13, which is placed spatially distant from the sensor 34.

Fig. 2 shows another embodiment of the invention, in which the sensor 34 is screwed into the port 6. In this case, a construction unit 36 is formed with the coupling head 1, the valve 13 and the sensor 34. This construction unit 36 communicates with the pressurised air system of the trailer via the outlet opening 14 when the counter coupling head is connected and apart from the outlet opening 14 and the port 4 only has an electrical interface 37, here with a connected electrical signal line 38, through which the output signal of the sensor 34 can be transmitted to other construction elements of the tractor, especially a control unit 39. As can be seen by comparing Figs. 1 and 2, the same coupling head 1 can be employed in a mounting environment

in which a pneumatical line is connected to the port 6, through which the branching line 7 is pneumatically connected to a distantly placed sensor 34, while in another mounting environment the sensor 34 is screwed into the port 6, so that the construction unit 36 in this case only communicates with the other construction elements through an electrical output signal via the electrical signal line 38.

Fig. 3 schematically shows the relevant parts of an agricultural tractor 40 with a hydraulical brake system 41, which serves for the actuation of hydraulical service brakes 42 according to actuation of a brake pedal 43, and a pneumatical brake system 44, which serves for the supply and the control of the pneumatical brake system of a trailer which can optionally be coupled to the tractor 40.

In the hydraulical brake system 41, actuation of the brake pedal 43 by a main cylinder 45, possibly with a brake force enhancer, is transformed into a hydraulical brake pressure, which is fed to the service brakes 42 via the hydraulical lines 46 shown in dashed lines. Actuation of the brake pedal 43, especially the actuation path or an actuation angle, is sensed via a sensor 47. Furthermore, the hydraulical brake pressure in a line 46 is sensed via a sensor 48. The output signals of the sensors 47, 48 are fed to control unit modules 52, 53 via suitable interfaces 51 by electrical signal lines 49, 50 shown as dashed-dotted lines. The signals are processed by the control unit modules 52, 53.

The pneumatical brake system 44 is supplied with pressurised air via a supply line 54 in a way not shown in more detail, for example from a compressor with subsequent air dryer and reservoir. The supply line 54 is led to the port 4 of the coupling head 1 and a supply port 56 of a trailer control valve 60 via a branching 55. With regard to the further design of the coupling head 1, which here is employed as coupling head supply, reference is made to the detailed description related to Fig. 1. The port 6 of the coupling head 1 is connected to a sensor 58 arranged with a distance to the coupling head 1 and which senses the pressure in the branching line 7 via a line 57 running externally of the coupling head 1. The output signal of the sensor 58 is fed to the control unit modules 52, 53 for further processing via an electrical signal line 59 and the interface 51.

The trailer control valve 60 has an inlet/outlet valve 61, via which a brake control pressure port 63 connected to a coupling head brake 62 can be connected to a deaeration 64 to decrease the

brake control pressure on the coupling head brake 62 and which can be sealed for holding constant the pressure at the coupling head brake 62. The inlet/outlet valve 61 is controlled by a balance piston 65. The underside of the balance piston 65 is biased by the pressure of the coupling head brake 62, while the upper side of the balance piston 65 limits a control chamber 66, so that the balance piston 65 is biased by a control pressure of the control chamber 66.

The control of the control pressure in the control chamber 66 is performed via two solenoid valves 67, 68, which are here realised as 2/2-way solenoid valves. The solenoid valve 68 connects the control chamber to the deaeration 64 in its energised position, while in its non-energised state it seals the connection of the control chamber 66 to the deaeration 64 due to the biasing by a spring. The solenoid valve 67 in the non-energised position connects the control chamber 66 to the central line 69 due to the biasing by a spring, while when it is energised, the solenoid valve 67 seals the connection between the control chamber 66 and the central line 69. The central line 69 can be connected to the supply port 56 via a further solenoid valve 70. For the embodiment shown, the solenoid valve 70 is realised as a 3/2-way valve, which in its energised position connects the central line 69 to the supply port 56, while a connection of the central line 69 to the hand brake port 71 is sealed. Without energising of the solenoid valve 70, due to the biasing by a spring, the solenoid valve 70 connects the central line 69 to the hand brake port 71, while the connection of the central line 69 to the supply port 56 is sealed.

The inlet/outlet valve 61 has a valve body 72 guided slidably in the trailer control valve 60. The valve body 72 works together with a valve seat 73 realised by the balance piston 65 on the one hand and a valve seat 75 realised by a housing 74 on the other hand in the following way:

- In the active position according to Fig. 3, the force due to the pressure on the coupling head brake 62 on the underside of the balance piston 65 dominates with respect to the force due to the pressure in the control chamber 66, so that the balance piston 65 is in its upper position, in which way a deaerating position is realised. In this deaerating position, between the valve seat 73 and the valve body 72 an annular passage for deaeration is formed. Due to the bias by a pressure spring 76, the valve body 72 is pressed against the valve seat 75, in which way a passage of pressurised air from the supply port 56 to the deaeration 64 and to the brake control pressure port 63 is sealed.

- When the control chamber 66 is pressurised, the balance piston 65 moves downwards until the valve seat 73 contacts the valve body 72, in which way a closed position of the inlet/outlet valve 61 is realised, in which the connections between the supply port 56, the brake control pressure port 63 and the deaeration 64 are sealed.

- If the pressure in the control chamber 66 is high enough to move the balance piston 65 further downwards from this sealing position, by this contact between valve seat 73 and valve body 72 the balance piston 65 presses the valve body further downwards against the biasing by the pressure spring 76. In this way between the valve seat 75 and the valve body 72 an annular passage for aeration is formed. Through this annular passage for aeration, pressurised air can pass from the supply port 56 to the brake control supply port 63 and to the coupling head brake 62. With increasing pressure build-up on the coupling head brake 62, the pressure biasing the underside of the balance piston 65 also rises. With a sufficient pressure increase on the underside of the balance piston 65, the balance piston 65 can be moved upwards again into the sealing position and, according to pressurising of the control chamber 66, back into the deaerating position as well.

Dependent on the control of the solenoid valves 67, 68, 70, aeration and deaeration of the control chamber 66 can be systematic, in which way ultimately the brake control pressure on the coupling head brake 62 can be set. If both solenoid valves 67, 68 are brought into their closed position, furthermore the pressure in the control chamber 66 can be held constant.

In the operating position not active in Fig. 3, the solenoid valve 70 connects the central line 69 to the supply port 56. If a brake supply pressure is to be produced on the coupling head brake 62 via a hand brake valve 77 (here realised as a rotary slide valve) the solenoid valve 70 is not energised and switched into the other operating position, which also is automatically done when the electrical power supply is interrupted. In this case, for the solenoid valve 67 in the aerating position, which according to Fig. 3 is also taken up when the electrical power supply is interrupted, the central line 69 and the control chamber 66 are connected to the hand brake port 71. Accordingly, ultimately the pressure in the control chamber 66, the operating position of the balance piston 65 and the brake control pressure on the coupling head brake 62 can be controlled via the hand brake valve 77. For the embodiment shown in Fig. 3, an inlet port 82 of the hand brake valve 77 and an inlet port 83 of a relay valve 84 are supplied with pressurised air via a branching 78 of the supply line 54 with a line 79 with integrated check valve 80, which enables a

flow of pressurised air from the supply line 54 but seals in the opposite direction, as well as a further branching 81. Dependent on the position of the actuation means 85 (here a selection lever) the hand brake valve 77 connects a parking brake port 86 of the hand brake valve 77 selectively to a deaeration 87 or an inlet port 82, in which way aerating or deaerating of spring-loaded parking brakes of the tractor dependent on the actuation means 85 can be achieved. Furthermore, the hand brake valve 77 has a control outlet 88, which is connected to a control port 89 of the relay valve 84 (which may according to Fig. 3 possibly be inverted). Through the hand brake valve 77 and depending on the position of the actuation means 85, the control port 89 can be aerated and deaerated by selective connection of the control outlet 88 with the aeration 87 or the inlet port 82. Using the relay effect of the relay valve 84, dependent on the pressure on the control port 89, i. e. depending on the position of the hand actuation means, the pressure on the hand brake port 71 can be modified which sets the pressure on the coupling head brake 62 when the solenoid valves 67, 68, 70 are not energised.

Preferably, the control unit module 53 is a control unit module which is responsible for a motor management. The control unit module 53 can communicate with further control unit modules (not shown) through unidirectional or bidirectional signal lines 90 or a CAN bus 91.

If via the sensor 58 a pressurising of the branching line 7 of the coupling head 1 is sensed, this can be analysed by the control unit modules 52, 53 in that a counter coupling head of the trailer is coupled to the coupling head 1. If for example the control unit module 53 detects that a joystick 92 is actuated by the driver in such a way that a braking of the tractor 40 is done without actuation of the service brakes, the control unit modules 52, 53 can control the trailer control valve 60 by electrical control of the solenoid valves 67, 68, 70 in such a way that a suitable brake control pressure is produced on the coupling head brake 62, which results in a braking of the trailer that corresponds to the braking achieved on the tractor 40 set by the joystick 92 or depends on this braking. It is also possible that the control unit modules 52, 53 make a targeted selection for parameters for a "solo tour" or "trailer tour" when it is detected by the coupling head 1 with the sensor 58 that a trailer is coupled and that the control unit modules 52, 53 initiate suitable measures for a stability control, reversing, driving in a circle, speed control, producing a trailer brake signal, activating the trailer control valve and others or for adjusting operating parameters. It is also possible that for the case that on the tractor a brake signal is produced (by the service brake and corresponding to actuation of the brake pedal 43 or by a parking brake and corresponding to actuation of the hand brake valve 77) a brake control pressure is controlled by

the trailer control valve 60 when the trailer is not coupled to the tractor, while the trailer control valve 60 is not activated without a trailer, in which way an electrical power intake is reduced.

It is furthermore possible that via the joystick 92 the drive engine of the tractor 40 and/or a transmission is controlled, so that a desired motion behaviour of the tractor set by the joystick 92 results. In this way for example a braking can be performed by changing the transmission ratio and therefore using the drive engine in a pushing operation. It is possible that when via the coupling head 1 it is detected by the sensor 58 that a trailer is coupled to the tractor, the control unit module 53 set or adjusts a speed limit for the motor management. This is especially important when the tractor 40 moves downhill with the trailer, which may be detected by a corresponding inclination sensor, the signal of which may also be fed to the control unit module 53. An automatised braking action is also executed without actuation of the service brakes 42 or parking brakes of the tractor 40 especially when the control unit module 53 receives the signal of an offroad switch according to which the user (in contrast to a road mode) has activated an offroad mode. In this case, when a critical driving state is detected, especially at a set inclination and a threshold speed, an automatic braking of the tractor and/or the trailer may be caused which may be executed with a control of the trailer brake valve 60 via the control unit modules 52, 53. Furthermore, a driving stabilisation of the vehicle chain of the tractor 40 and the trailer may be achieved if an unstable drive state is sensed and a signal is present via the coupling head 1 with the sensor 58 which indicates that a trailer is coupled to the tractor 40. In this case, for example a stretching brake function may be automatically activated in which through the control unit modules 52, 53 the trailer control valve 60 is controlled in such a way that a brake control pressure at the coupling head brake 62 is produced which guarantees the presence of a coupling drag force in the mechanical coupling between tractor and trailer 40. It is furthermore possible that a running-up of the tractor is automatically detected by the control unit modules 52, 53. If the control unit modules 52, 53 based on the signal of the sensor 58 have detected that a trailer is coupled to the tractor 40 and on the vehicle wheels acceleration states are detected which cannot be traced back to the drive moment of the drive aggregate of the drive train of the tractor 40 but can be traced back to a "pushing" of the trailer, appropriate measures can be taken. These measures can for example be the production of an "additional" brake control pressure for the trailer. This of course applies accordingly for the acceleration states of the tractor - if the tractor 40 does not follow the set acceleration as desired, this allows to conclude on a lack of acceleration or brake force being present on the trailer. When reversing and a coupled trailer are detected, a speed limit may be set. When driving in a circle, a speed limit can also be set when a trailer is coupled.

A stretching brake function can especially be employed during driving in a curve or circle. It is possible that the control unit module 53 works together with an ABS control and at least one revolution speed sensor of a vehicle wheel to conduct a driving dynamic control and to detect whether the tractor 40 is being pushed or braked by the trailer. For this purpose, especially wheel rotation speed sensors 93 are employed, which are shown in Fig. 7. The control unit modules 52, 53 in this case form a spread-out control unit 39.

With a design that otherwise corresponds to Fig. 3, according to **Fig. 4** a 2/2-way solenoid valve 94 is placed in the supply line 54 between the branchings 78, 55 which takes on a pass position when it is not energised according to Fig. 4, while when it is energised against the biasing by a spring it takes on a throttled pass position. If it is detected that a coupling head 1, 62 has been torn off, the 2/2-way solenoid valve 94 is brought into its throttle position to reduce the use of pressurised air. That the coupling head supply 1 has been torn off (or a leakage in an associated supply line) can be detected by a pressure drop at the sensor 58. If a control unit module 52, 53 senses such a pressure drop based on the measurement signal of the sensor 58, the control unit module 52, 53 can bring the 2/2-way solenoid valve 94 into the throttle position. A pressure sensor can also be integrated into the trailer control valve 60 in a way not shown. The pressure sensor senses the brake control pressure at the coupling head brake 62. If such a sensor detects a brake control pressure which does not correspond to the brake control pressure curve according to the preset by the control of the solenoid valves 67, 68, 70, it can be concluded that a leakage has occurred or the coupling head brake 62 or the assigned brake control pressure lines have been torn off and the 2/2-way solenoid valve 94 can be brought into its throttle position. It is understood that the pressure sensor 58 can also be integrated into the trailer control valve 60, can be integrated into the coupling head 1 as this is shown in Fig. 2 and/or a sensor for sensing the brake control pressure may be arranged outside of the trailer control valve 60.

In Fig. 4 besides the control unit module 53 (which is amongst other things responsible for a motor management), a control unit module 95 is shown which is responsible for the transmission management and exchanges signals with the control unit module 53 (and the control unit module 52). As explained above, when the transmission ratio is changed by the control unit module 95, a corresponding brake control pressure can be produced through the trailer control valve 60.

While according to the embodiment according to Figs. 3 and 4 the brake control pressure at the coupling head brake 62 is only electrically modified or controlled through actuation of the solenoid

valves 67, 68, 70 according to actuation of the brake pedal 43, for the embodiment according to **Fig. 5** the brake control pressure can be alternatively set by electrical control of the trailer control valve 60 by the control unit modules 52, 53 and an additional trailer control valve 96 which in the embodiment shown is hydraulical-pneumatical. In order to achieve this, the trailer control valve 96 has a hydraulical inlet port 97, which is connected to the hydraulical line 46. Furthermore, the trailer control valve 96 has a supply port 102 which is supplied with pressurised air from the control line 54. Finally, the trailer control valve 96 has a brake control pressure port 98, which is connected to an inlet port 99 of the trailer control valve 60, where the inlet port 99 corresponds to the hand brake port 71 according to the embodiment shown in Fig. 3. The trailer control valve 96 has a hydraulically biased piston 100 which acts on a balance piston 101, the operating position of which in turn controls the valve position of an inlet/outlet valve 101. Ultimately, the trailer control valve 96 produces a brake control pressure on the brake control pressure port 98 depending on the hydraulical pressure on the inlet port 97 by connecting the brake control port 98 to the control port 102 or by deaeration of the trailer control valve 97 or blocking of the brake control pressure port 98. Furthermore, for the embodiment shown, the hand brake valve 77 is integrated into the trailer control valve 96, so that the brake control pressure on the brake control pressure port 98 can also be influenced by manual actuation of the actuation means 85. For further details of the trailer control valve 96 and the possibilities for its modification reference is especially made to the document DE 10 2009 045 191 A1, the disclosure of which is incorporated into the present patent application.

If the solenoid valves 67, 68, 70 are in a non-energised state, which may be the case at an electrical power drop or the targeted result of the control by the control unit modules 52, 53, the brake control pressure on the brake control pressure port 98 of the trailer control valve 96 is passed on through the trailer control valve 60 from the inlet port 99 to the brake control pressure port 63 and therefore to the coupling head brake 62, so that the control of the brake control pressure is achieved by the trailer control valve 96. Besides a fallback or redundancy level for the electrical power drop formed in such a way, even during normal operation of the tractor with trailer an alternative use of the trailer control valves 60, 69 for the setting of the brake control pressure may be achieved. For example, in a normal operation the control may be provided by the trailer control valve 96, while in selected operating situations the trailer control valve 60 takes over control of the brake control pressure. For example, by use of the electrically controlled trailer control valve 60 the brake control pressure can be made to lead. It is also possible that by a directed action of the trailer control valve 60, for example in unstable driving situations, the strict

dependency of the brake control pressure from the hydraulical pressure which is compulsively set by the trailer brake valve 96 is temporarily repealed in which way the options for the control of the brake system of the trailer are enlarged.

Any construction elements mentioned and shown may be singular construction elements, form modules which can be selectively combined, for example flanged to one another, or be combined into construction units. According to Fig. 5 and deviating from Fig. 4, the trailer control valve 60, the sensor 58 and the 2/2-way solenoid valve 94 have been combined into a construction unit 103. This construction unit 103 has

- an interface 51 for feeding a signal of the sensor 48 to the construction unit 103 and therefore to the control unit module 52,
- an interface 51 for connecting the control unit module 52 to the sensor 47 and the control unit module 53 (and via this module to the signal lines 90, the CAN bus 91 or further control unit modules),
- a pneumatical port for the coupling head brake,
- a pneumatical port for the coupling head brake 62,
- a pneumatical port each for the coupling head supply 1 and for the branch line 7,
- a supply port and
- an inlet port 99.

As shown, the construction unit 103 can have an additional control port, via which the brake control pressure port 98 of the trailer control valve 96 is connected to a pneumatical control port 104 of the 2/2-way solenoid valve 94, the pressurising of which results in an actuation of the 2/2-way solenoid valve 94 into the throttle position. From the coupling head line 5, too, a control line branches off within the construction unit 103, which is connected to the control port 105, the pressurising of which biases the 2/2-way solenoid valve 94 into its pass position.

Additionally (deviating from Fig. 5) a check valve may be placed upstream of the supply port 102 in the line branch vertical in Fig. 5. This ensures keeping up a pressure at the supply port 102 even when the supply line 54 becomes depressurised, for example by a defect in the region of the coupling head 1. Therefore, the function of the mechanical fallback level can be kept up in the form of the trailer control valve 96 and it can be guaranteed that the 2/2-way solenoid valve in this

case keeps up its throttle position, which also can be guaranteed if there is a drop in electrical power supply.

Deviating from the embodiment according to Fig. 3, according to **Fig. 6** instead of the combination of the hand brake valve 77 and the (inverted) relay valve 84, an electrical hand brake valve 106 is employed, which produces an electrical control signal in an electrical control line 108 which depends on the position of the actuation means 107. The control signal in the control line 108 is fed to a control port 109 of an electrically actuated proportional valve 110. The proportional valve 110 is supplied with pressurised air by the supply line 54 with a check valve 80 interposed and causes a brake control pressure on the hand brake port 71 of the trailer control valve 60 which is dependent on the control signal in the control line 108 and therefore from the position of the actuation means 107 of the hand brake valve 106.

According to Fig. 6, the hydraulical brake system 41 has two circuits so that the actuation of the brake pedal 43 via the main cylinder 45 produces hydraulical pressures in the lines 46a, 46b, which are fed to service brakes 42a, 42b of the respective brake circuits and sensed via sensors 48a, 48b. The measurement signals of the sensors 48a, 48b are fed to the control unit module 52 via the interface 51 and processed by the control unit module 52.

According to Fig. 6, furthermore an optional modification has been performed in such a way that via the coupling head line 5 an (inverted) control valve with a pressure limitation 111 is supplied with pressurised air, the control port 112 of which is pressurised with the brake control pressure on the coupling head brake 62. On its outlet side, the control valve with pressure limitation 111 is connected to a coupling head 113, where the pressure on the coupling head 113 is sensed with a sensor 120 and is fed to the control unit module 53. This embodiment is designed for a trailer with a single pipe brake or single circuit brake, which preferably is the case for trailers with a maximum speed which is smaller than 25 km/h. An increasing brake control pressure on the coupling head brake 62 leads to the results that the pressure at the coupling head 113 falls which is due to the inverted design of the control valve with pressure limitation 111. This falling pressure is converted back into an increasing pressure by the single pipe trailer brake valve of the trailer, which is then fed to the service brakes of the trailer.

Fig. 7 shows an embodiment with a hand brake valve 77, the outlet pressure of which is not fed to the trailer control valve 60 via a relay valve but directly. In this case, according to Fig. 6 a two-

circuit hydraulical brake system 41 is employed and as an example the pneumatical brake system 44 is intended for a trailer with a single pipe brake or single circuit brake. According to Fig. 7, a construction unit 114 is employed, into which

- the check valve 80,
- the 2/2-way solenoid valve 94,
- a module 115 with a sensor 116 for sensing the output pressure of the hand brake valve 77, the sensors 48a, 48b, a sensor 117 for sensing the brake control pressure, a sensor 118 for sensing the pressure on the output side of the 2/2-way solenoid valve 94 and a sensor 119 for sensing the pressure in the supply line 54

are integrated. The construction unit 114 also has

- a pneumatical port for the connection to the supply line 54,
- a pneumatical port for supplying hand brake valve 77 with pressurised air,
- a pneumatical inlet port for the supply of the output pressure of hand brake valve 77,
- a brake control pressure port 63 and
- an outlet port for the supply of the coupling head line 5 of the coupling head 1.

Furthermore, the construction unit 114 has hydraulical ports for a hydraulical connection to the lines 46a, 46b. Finally, the construction unit 114 has electrical interfaces for feeding the signal of the rotation speed sensor 93 and for a communication of the control unit modules 52, 53, 95 and further sensors and control unit modules.

While for the embodiments according to Figs. 1 to 7 the sensor 34 was realised as a pressure sensor 121, **Fig. 8** shows a different embodiment of a coupling head 1, in which the sensor 34 is realised as a displacement sensor 122. In this case a core 123 is mounted to the valve body 9, so that this core 123 is moved together with the valve body 9 from the closed position shown in Fig. 8 into the open position when the coupling head 1 is coupled to a counter coupling head. The core 123 changes its extension in the coil 124 of the displacement sensor 122, in which way a measurement signal of the displacement sensor 122 can be produced. The displacement sensor 122 is equipped with a plug or an interface 125, through which on the one hand a power supply of the displacement sensor 122 can be achieved and on the other hand the displacement sensor 122 can communicate with an interface 51, a control unit module 53, a control unit module 95, ...,

so that an analysis and use of the measurement signal can take place as explained before. It is understood that instead of the realisation of the displacement sensor 122 with a core 123 and a coil 124 any other concept for a displacement sensor 122 can be employed, where a velocity sensor can also be employed, for example with an integration of the velocity signal into a displacement signal.

Generally, coupling heads of different designs especially with regard to their technical function, the constructive design, the coupling to a counter coupling head are known, for example as two-pipe or two-circuits coupling heads of the WABCO company in the model types 952 200 021 0, 952 200 210 0, 952 200 221 0, 952 200 022 0, 952 200 222 0 and as "Duo-Matic" express couplings for trailers or semitrailers in model types 452 802 009 0, 452 804 012 0 for compound vehicles and model types 452 805 004 0 and 4452 803 005 0 for drawbar trailer combinations. The inventive measures can be integrated into all such known coupling heads or be used cumulatively.

LIST OF REFERENCE NUMERALS

1	coupling head
2	base body
3	fixing element
4	port
5	coupling head line
6	port
7	branch line
8	connection region
9	valve body
10	valve body part
11	valve body part
12	valve seat
13	valve
14	outlet opening
15	coupling head chamber
16	guidance bore
17	sealing element
18	vertical arm
19	through bore
20	horizontal arm
21	collar
22	valve seal
23	pressure spring
24	base arm
25	side arm
26	side arm
27	thickening
28	guidance bore
29	sealing element
30	through bore
31	ridge
32	contact surface

33 through hole
34 sensor
35 construction unit
36 construction unit
37 electrical interface
38 electrical signal line
39 control unit
40 agricultural tractor
41 hydraulical brake system
42 service brake
43 brake pedal
44 pneumatical brake system
45 main cylinder
46 hydraulical line
47 sensor
48 sensor
49 signal line
50 signal line
51 interface
52 control unit module
53 control unit module
54 supply line
55 branching
56 supply port
57 line
58 sensor
59 signal line
60 trailer control valve
61 inlet/outlet valve
62 coupling head brake
63 brake control pressure port
64 deaeration
65 balance piston
66 control chamber

67 solenoid valve
68 solenoid valve
69 central line
70 solenoid valve
71 hand brake port
72 valve body
73 valve seat
74 housing
75 valve seat
76 pressure spring
77 hand brake valve
78 branching
79 line
80 check valve
81 branching
82 inlet port
83 inlet port
84 relay valve
85 actuation means
86 parking brake port
87 deaeration
88 control outlet
89 control port
90 signal line
91 CAN bus
92 joysticks
93 wheel revolution sensor
94 2/2-way solenoid valve
95 control unit module
96 trailer control valve
97 inlet port
98 brake control pressure port
99 inlet port
100 piston

101 balance piston
102 supply port
103 construction unit
104 control port
105 control port
106 hand brake valve
107 actuation means
108 control line
109 control port
110 proportional valve
111 control valve with pressure limitation
112 control port
113 coupling head
114 construction unit
115 module
116 sensor
117 sensor
118 sensor
119 sensor
120 sensor
121 pressure sensor
122 displacement sensor
123 core
124 coil
125 plug

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SZABADALMI IGÉNYPONTOK

MEZŐGAZDASÁGI VONTATÓJÁRMŰ

1. Mezőgazdasági vontatójármű (40) egy

a) hidraulikus fékberendezéssel (41),

b) egy pneumatikus fékberendezéssel (44) egy a vontatójárműhöz (40) csatlakoztatható utánfutó számára,

c) egy pneumatikus kuplungfejjel (1), amelyen keresztül az utánfutó ellenkuplungfejével van összekapcsolva a nagynyomású levegő a vontatójármű (40) és az utánfutó között átvihető,

d) egy a kuplungfejbe (1) beépített szeleppel (13),

azzal jellemezve, hogy

e) a kuplungfejbe (1) beépített szelep (13) egy kuplungfej vezeték (5) és egy oldalvezeték (7) közé van beiktatva és

f) a kuplungfejbe (1) beépített szelep (13) az ellenkuplungfejjel való összekapcsolásával automatikusan nyitott állapotba kerül, amelyben a kuplungfej vezeték (5) az oldalvezetékkel (7) pneumatikusan össze van kötve,

g) egy érzékelőt (34, 58) az oldalvezetékben (7) lévő nyomást figyeli.

2. Az 1. igénypont szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy az érzékelő (34, 58) által kibocsátott elektromos jel egy vezérlőegységbe (39, 52, 53, 95) van bevezetve.

3. Az 1. vagy a 2. igénypont szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a kuplungfej (1), a szeleppel (13) és az érzékelővel (34) egy építési egységeként (36) van kialakítva.

4. Az 1. vagy a 2. igénypont szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy

a) a kuplungfejjel (1) és a szeleppel egy építési egységként (35) van kialakítva,

b) az érzékelő (58) az építési egységtől (35) külön van elrendezve, és

c) az érzékelő (58) és az építési egység (35) egy vezetéken (57) vagy az oldalvezetéken (7) keresztül van egymással összekötve.

5. Az 1-4. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy

a) a szelep egy szeleptesttel (9) egy ülékes szelepként van kialakítva, amelyet az utánfutó nem csatlakoztatott ellenkuplungfeje esetén egy rugó (23) a szeleptüléknek (12) nyom, és

b) a szeleptest (9) az ellenkuplungfej csatlakoztatásával egy csatlakozó elemen keresztül a szeleptülékről (12) elmozdul a rugó (23) alatt.

6. A 2-5. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy szabályzási logikát tartalmaz, amely

a) egy hajtásteljesítményt

b) egy fékteljesítményt

c) egy menetstabilitás szabályozást és/vagy

d) a vontatójármű egy menetdinamikai szabályozását

befolyásolja, az érzékelő (34, 58) által az oldalvezetékben (7) felvett jel függvényében.

7. A 2-6. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) olyan vezérlési logikával van ellátva, amely az érzékelő (34, 58) által kibocsátott jel alapján a meghajtás egy hajtásállapotát befolyásolja.

8. A 2-7. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52,53,95) olyan vezérlési logikával van ellátva, amely a vontatójármű (40) fékezését a vontatójármű üzemi fékének (42) működtetése nélkül állítja elő, amely jelzi, hogy egy utánfutó a vontatójárműre (40) van csatlakoztatva, egy utánfutó vezérlőszelep (60) pedig úgy van vezérelve, hogy egy pneumatikus féknyomást állít elő az utánfutó számára.

9. A 8. igénypont szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely a vontatójármű (40) fékezését a vontatójármű (40) üzemi fékének (42) működtetése nélkül a vezető által működtetett joystick (92) állásának függvényében ismeri fel.

10. A 2-9. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely az érzékelő (34; 58) által adott jel függvényében egy elektromos fékjelet bocsájt ki az utánfutó számára.

11. A 2-10. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely egy utánfutó-vezérlést hajt végre, ahol az utánfutó vezérlés az érzékelő (34; 58) jelének függvényében történik.

12. A 2-11. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely az érzékelő (34; 58) által kibocsátott jel függvényében egy sebességkorlátozást hajt végre.

13. A 2-11. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely egy offroad-kapcsoló egy kapcsolóállása szerint van meghatározva, ahol a vezérlőegység (39; 52, 53, 95) az utánfutó és/vagy a vontatójármű (40) egy automatikus fékezőerő változtatását hozza létre

a) az offroad-kapcsoló állásának függvényében

b) az érzékelő (34, 58) által kibocsátott jel függvényében.

14. A 2-13. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely az érzékelő (34; 58) által kibocsátott jel függvényében egy vontatófék funkciót aktivál.

15. A 2-14. igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) egy olyan vezérlési logikával van ellátva, amely az érzékelő (34; 58) által kibocsátott jel függvényében egy, a vontatójármű (40) és az utánfutó közötti csatlakozóerő értékelését végzi.

16. A 8. igénypont szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a vezérlőegység (39; 52, 53, 95) a megbecsült kapcsolási erő függvényében hatással van az

a) hajtásteljesítményre,

b) vontatójármű fékerejére,

c) az utánfutó fékerejére,

d) a menetstabilizáló szabályozásra és/vagy,

e) a vontatójármű menetdinamikai szabályozására,

f) csatlakozási erőre.

17. Az előző igénypontok egyike szerinti mezőgazdasági vontatójármű (40), azzal jellemezve, hogy a szelep (13) amely a kuplungfej vezeték (5) és az oldalvezeték (7) között van a kuplungfej vezeték (5) és a kimeneti nyílás (14) közé van kapcsolva.

18. Pneumatikus kuplungfej (1), egy az 1-17. igénypontok egyike szerinti vontatójármű, különösképp egy mezőgazdasági vontatójármű egy utánfutóval való csatlakoztatására,

a) egy, szeleptesttel (9) ellátott, a kuplungfejbe (1) beépített szeleppel (13), amelynek van

aa) egy zárt állása, amelyben a kuplungfej (1) a környezettől el van zárva

ab) egy nyitott állása, amelyben a kuplungfej pneumatikusan össze van kapcsolva az ellenkuplungfejjel,

azzal jellemezve, hogy

b) a szeleptest (9) a kuplungfej (1) csatlakozási folyamata során egy ellenkuplungfej által automatikusan zárt állásból nyitott állásba van átvezetve,

c) egy érzékelője (34, 58) amely a beépytett szelep (13) szeleptestének (9) a kuplungfejben (1) lévő helyzetét közvetlenül vagy közvetetten érzékeli.

19. A 18. igénypont szerinti pneumatikus kuplungfej (1), azzal jellemezve, hogy az érzékelő (34; 58) egy útérzékelő (122) amely a szeleptest (9) állását érzékeli.

20. A 18. igénypont szerinti pneumatikus kuplungfej (1), azzal jellemezve, hogy az érzékelő (34; 58) egy nyomásérzékelő (121) amely a szeleptest (9) állásától függő nyomást érzékeli.

21. A 20. igénypont szerinti pneumatikus kuplungfej (1), azzal jellemezve, hogy

a) a szelep (13) a kuplungfej vezeték (5) és az oldalvezeték (9) közé van iktatva,

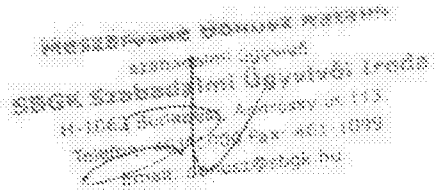
b) a szeleptest (9) zárt állásában a kuplungfej vezeték (5) az oldalvezetéktől (7) pneumatikusan el van választva, és az oldalvezeték (7) le van szellőztetve és

c) a szeleptest nyitott állásánál a kuplungfej vezeték (5) pneumatikusan az oldalvezetékkel (7) össze van kötve, és

d) a nyomásérzékelő (122) az oldalvezeték (7) nyomását érzékeli.

22. A 19. igénypont szerinti pneumatikus kuplungfej (1), azzal jellemezve, hogy a kuplungfej (1) a szeleppel (13) és egy érzékelővel (34) egy építési egységet (36) alkot.

A meghatalmazott:



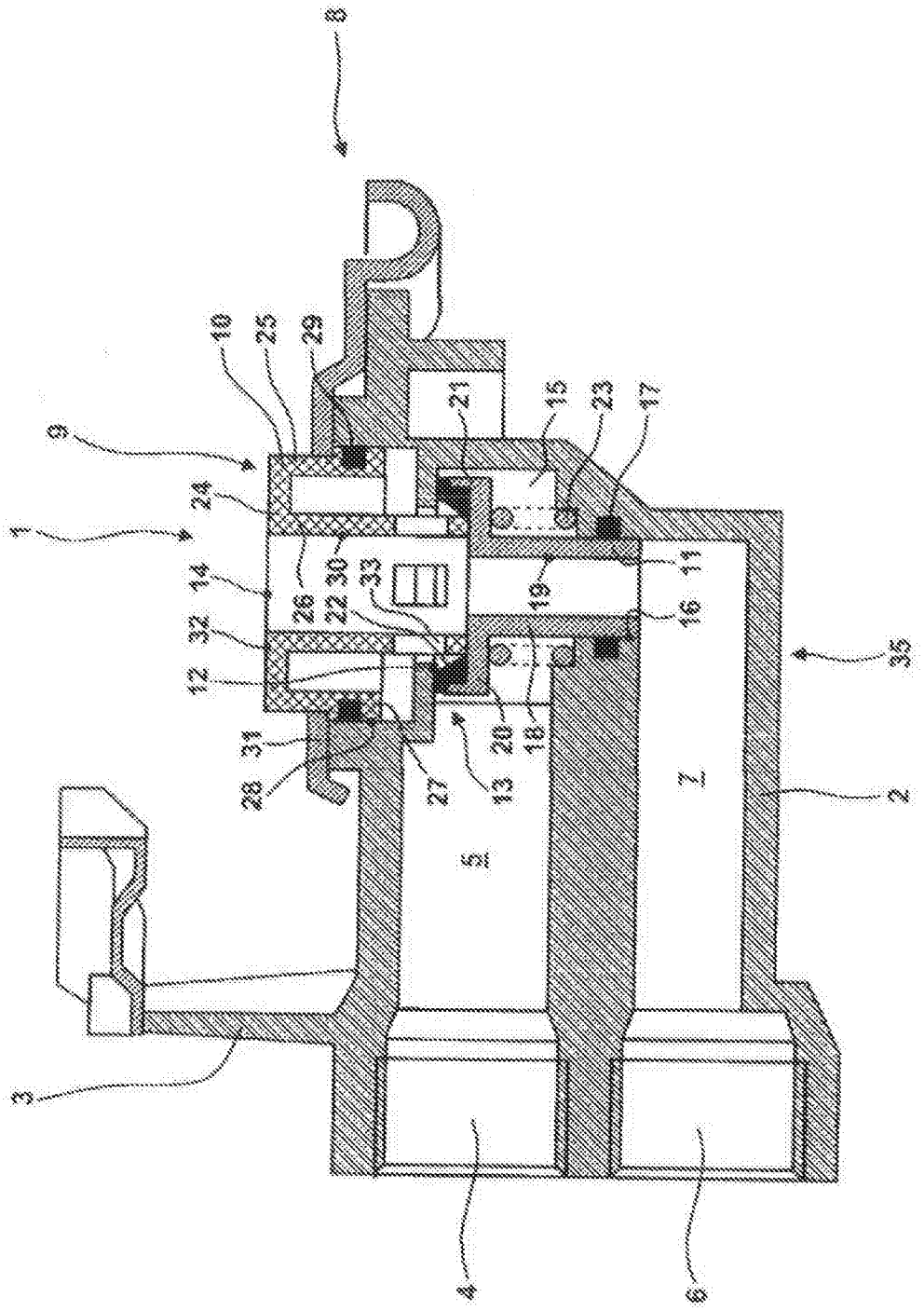


Fig. 1

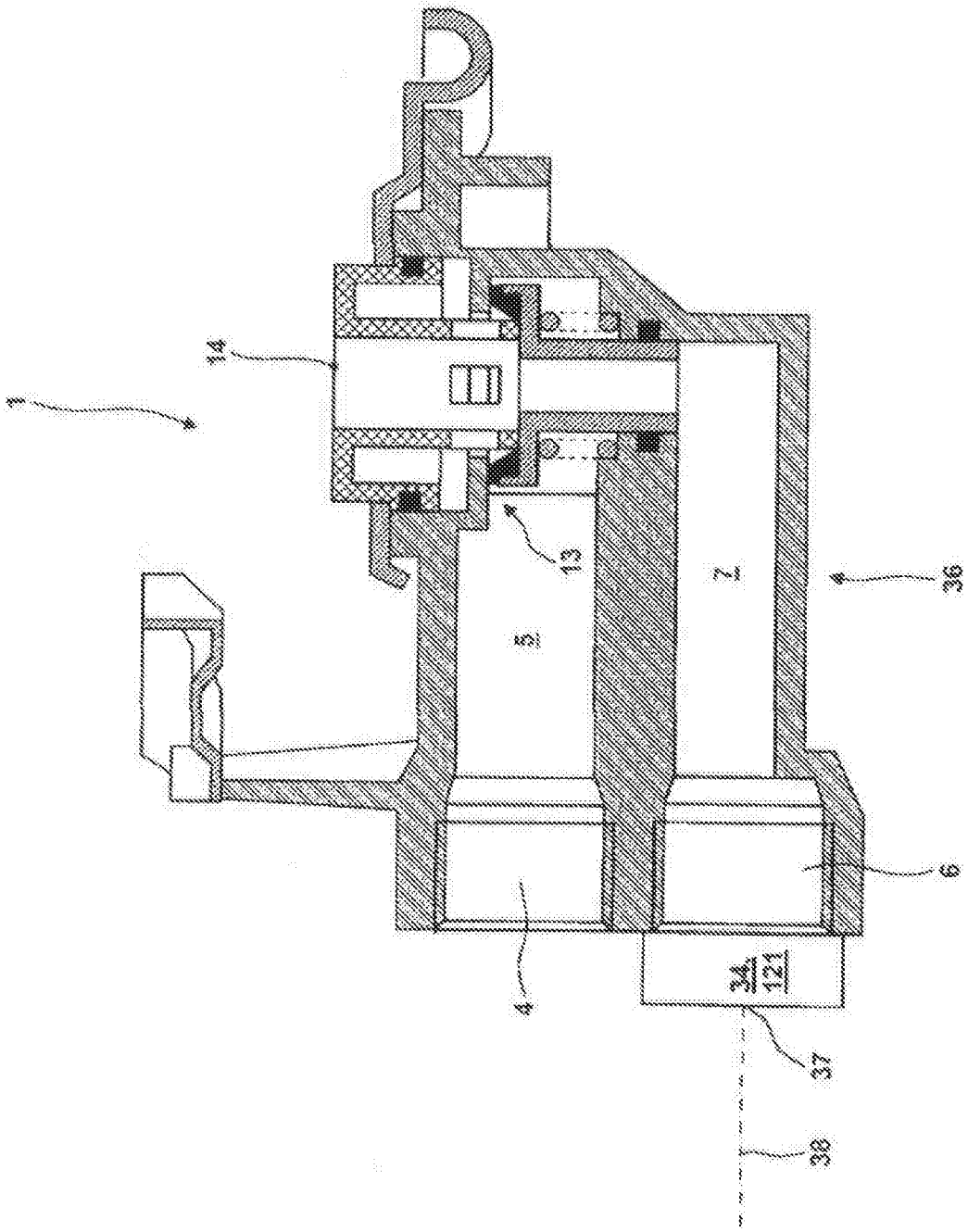


Fig. 2

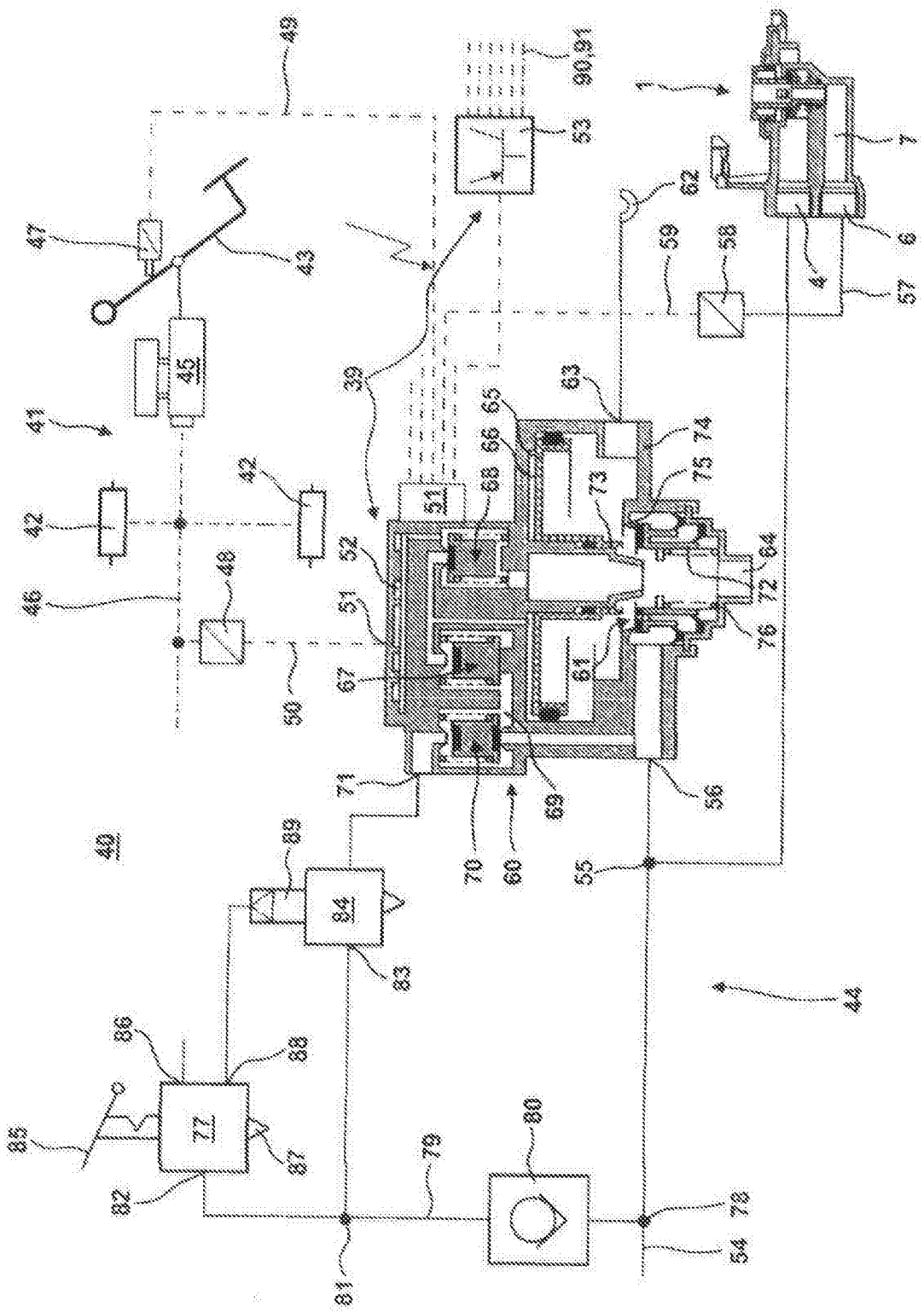

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Fig. 3

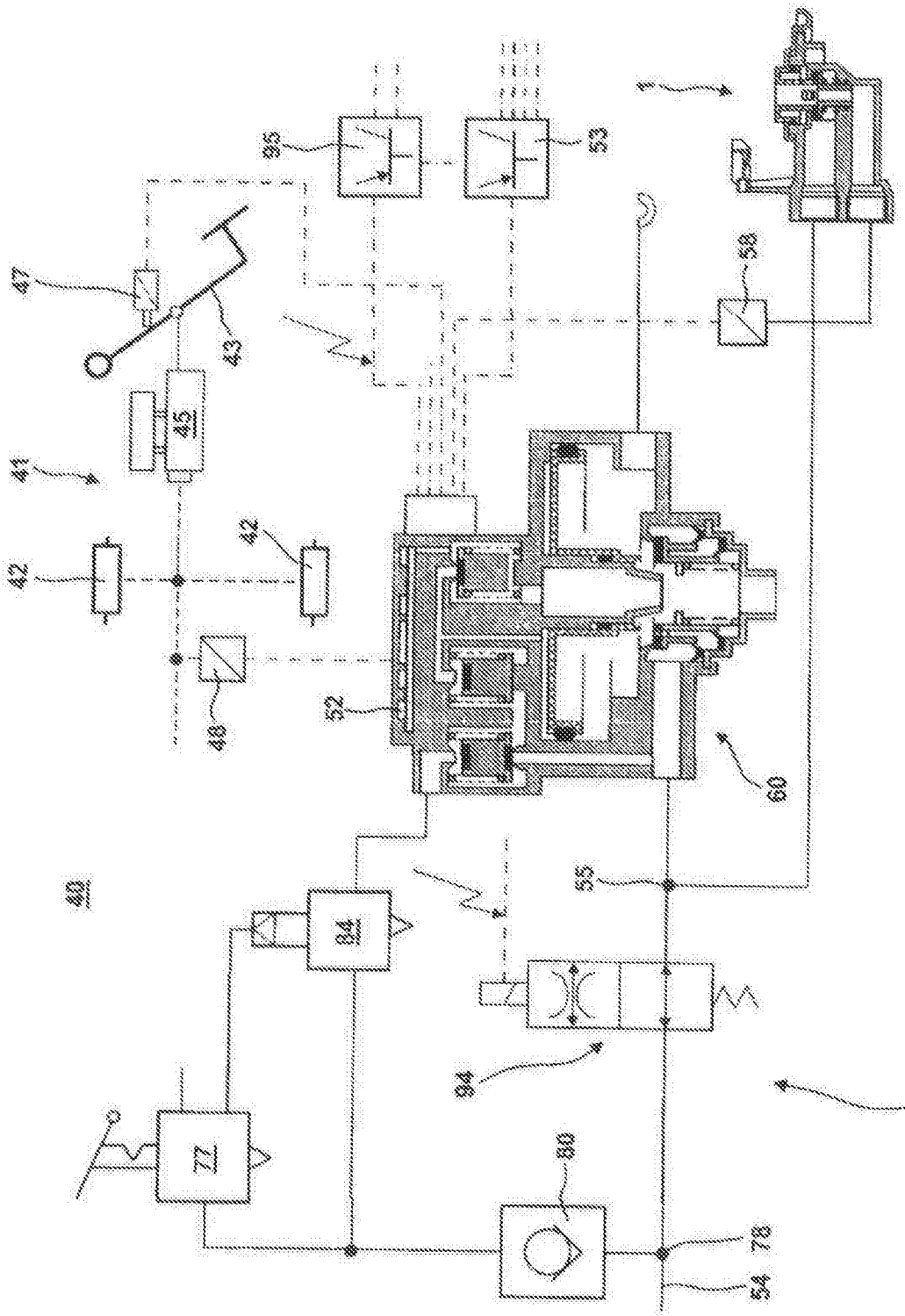

Fig. 4

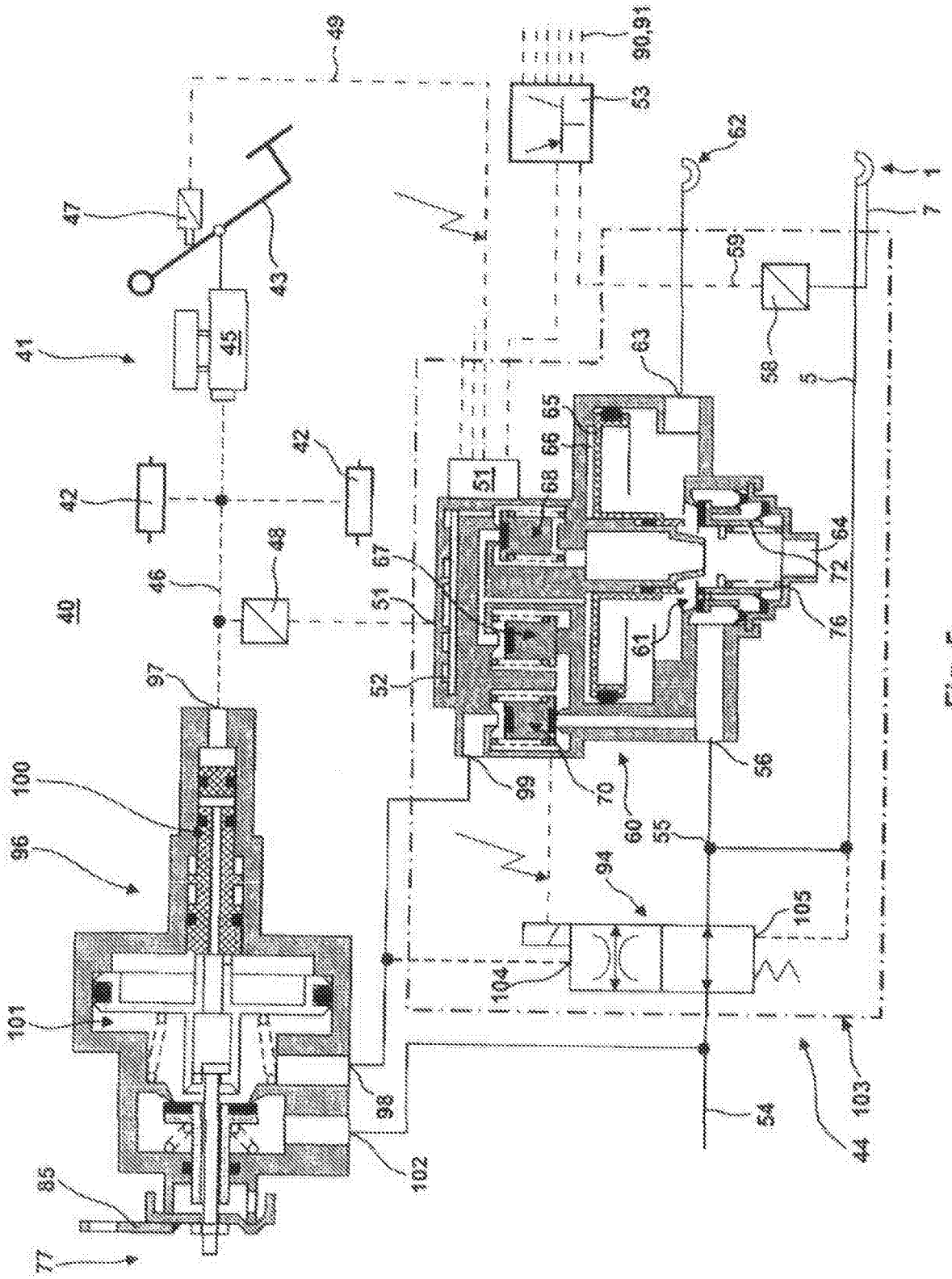
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Fig. 5

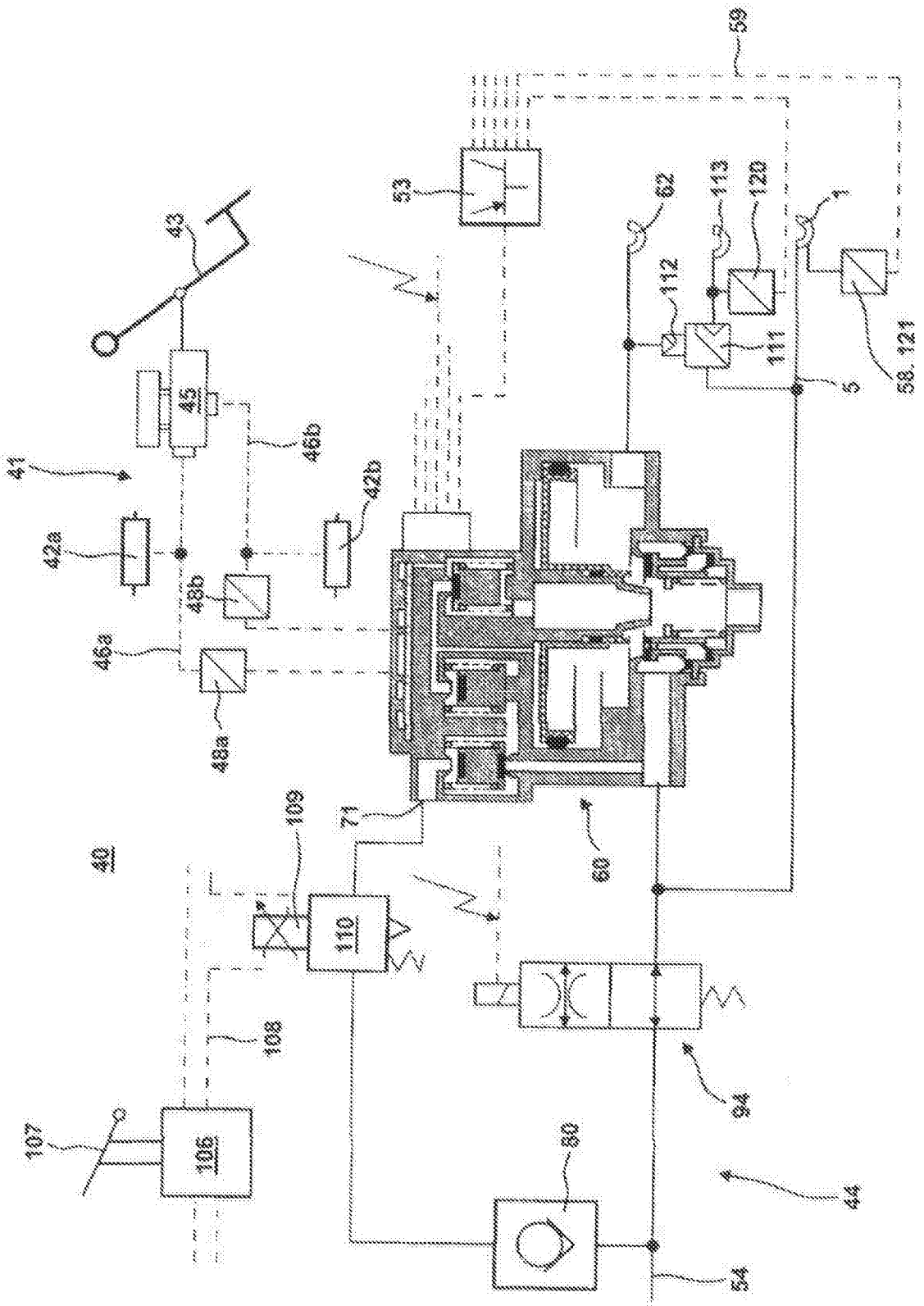
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Fig. 6

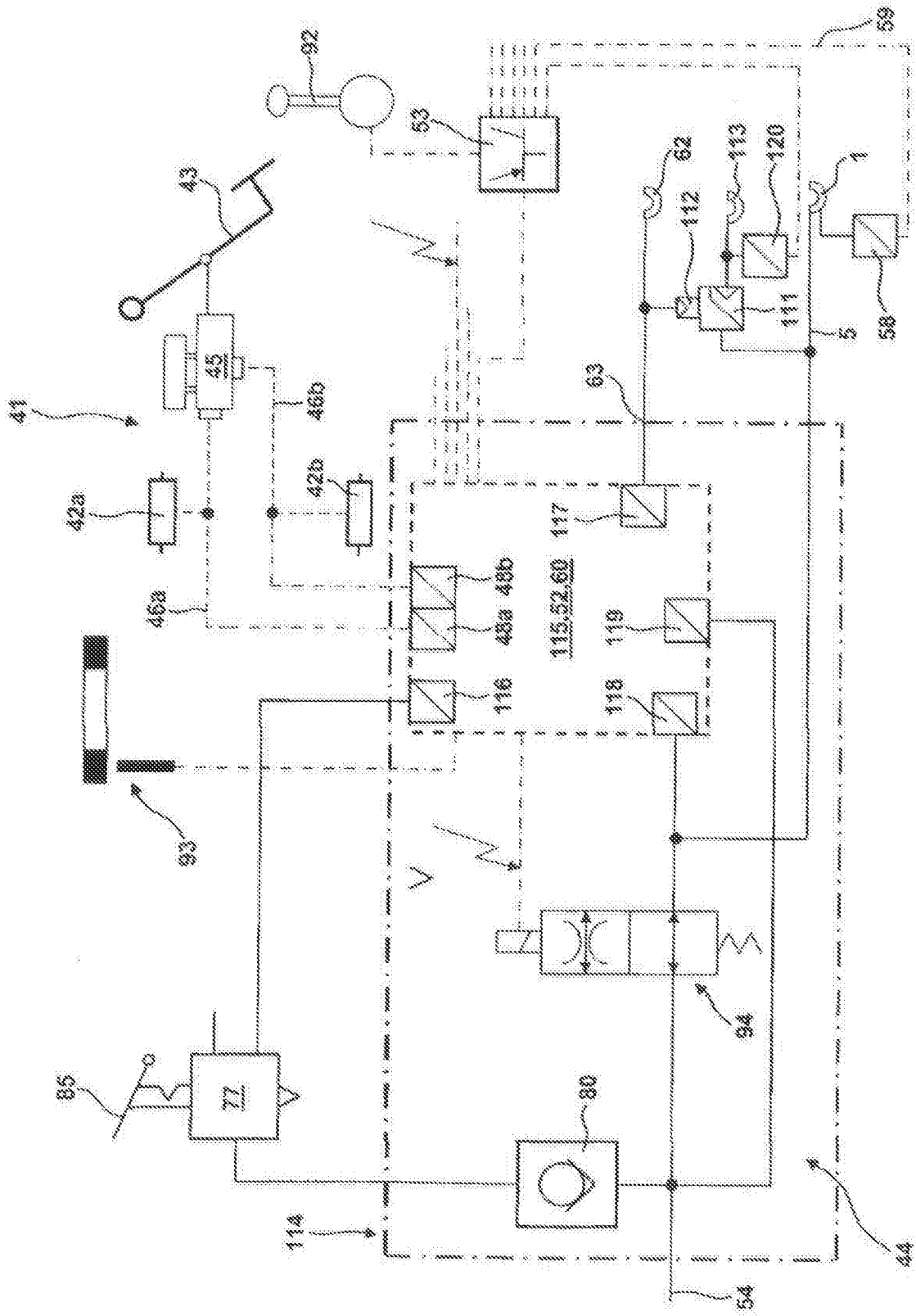
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Fig. 7

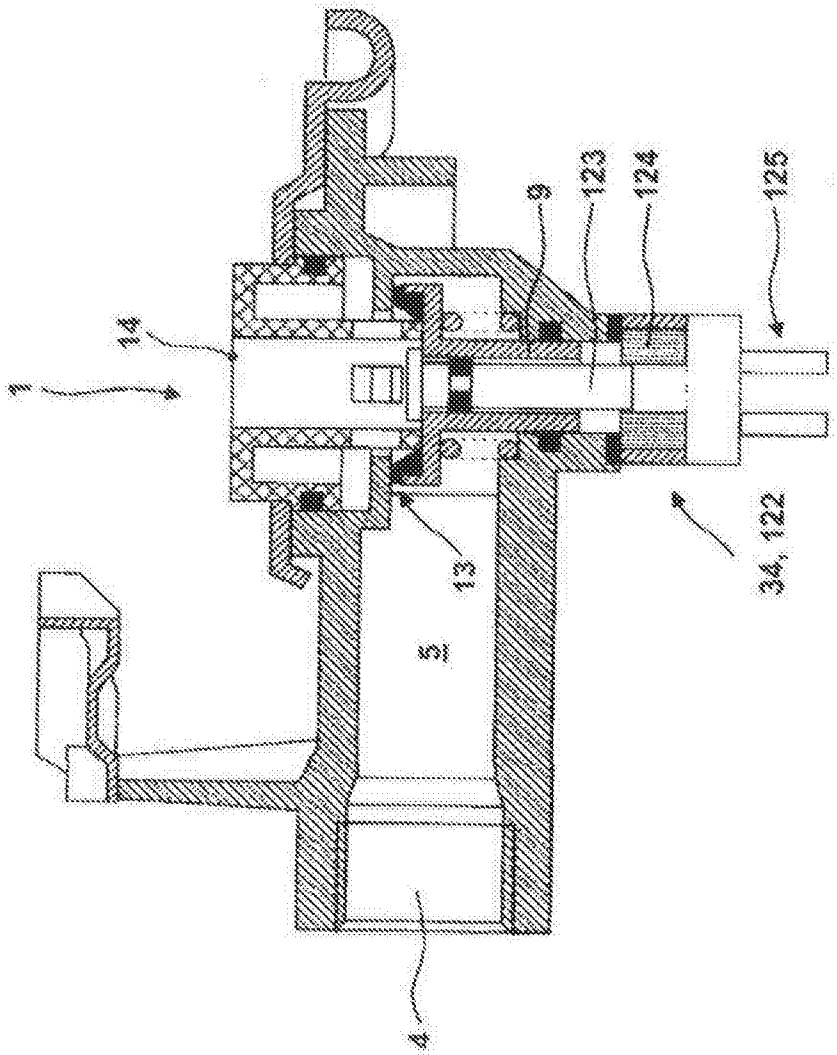

Fig. 8