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Vacuum assisted line bleeding

Abstract

A bleeder system having a check valve selectively enables or inhibits fluid communication. A first tube provides fluid communication between the check valve and a bleeder valve of a hydraulic system. A fluid recovery reservoir receives at least one of air and hydraulic fluid, with a second tube connected between the check valve and the fluid recovery reservoir to provide fluid communication between the check valve and the fluid recovery reservoir. A vacuum pump selectively draws a vacuum, with a third tube connected between the vacuum pump and the fluid recovery reservoir to provide the vacuum from the vacuum pump to the fluid recovery reservoir. A power source provides power to the vacuum pump.

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Background/Summary

FIELD

(1) This invention relates to the field of pressurized fluid systems. More particularly, this invention relates to bleeding air from a fluid line.

INTRODUCTION

(2) Fluid-driven systems, such as brake lines, hydraulic lines, and so forth, operate by putting a relatively non-compressible fluid under pressure, such as with a pump of some kind, and conducting the pressurized fluid through hoses to where a desired operation is to be performed, such as moving a piston. The entire system is preferably kept in a closed state, or in other words, in a state where a compressible fluid-such as air-cannot get into the system. If air infiltrates the closed

system, then the air tends to compress before the desired operation can be accomplished, which might require more force than remains after the air is compressed.
(3) Removing air from the fluid system is a process that typically needs to be accomplished both when the system is first charged with fluid, or anytime the sealed system is opened to the atmosphere, such that air can get into the system. This is typically referred to as bleeding the system. It is a relatively simple process, but can be quite cumbersome and time consuming, and require several people to perform.
(4) For example, a typical method might require one person to operate the pressurizing pump so as to move the fluid from a fluid reservoir to the hoses, another person to keep the fluid reservoir filled so that it doesn't empty and begin to aspirate air, and yet another person to open and close a so-called bleeder valve at the operative end of the system, such as at the piston. The bleeder valve is initially opened so that the air in the system can be pushed out, and then the bleeder valve is closed once the fluid starts to come out of the hose, and no more air bubbles are entrained in the stream of fluid.
(5) In systems that are manually pumped, such as car brakes, the bleeder valve must be opened upon every pressurizing stroke, and then closed before each recovery stroke, so that the recovery of the brake pedal doesn't just pull the fluid back toward the reservoir. This process of pumping and recovering, and opening and closing the bleeder valve, is cyclically repeated until the system is discharged of air.
(6) What is needed, therefore, is a system for bleeding a fluid-driven system that tends to reduce, at least in part, issues such as those suggested above.
SUMMARY
(7) The above and other needs are met by a bleeder system having a check valve to selectively enable or inhibit fluid communication. A first tube provides fluid communication between the check valve and a bleeder valve of a hydraulic system. A fluid recovery reservoir receives at least one of air and hydraulic fluid, with a second tube connected between the check valve and the fluid recovery reservoir to provide fluid communication between the check valve and the fluid recovery reservoir. A vacuum pump selectively draws a vacuum, with a third tube connected between the vacuum pump and the fluid recovery reservoir to provide the vacuum from the vacuum pump to the fluid recovery reservoir. A power source provides power to the vacuum pump.
(8) In some embodiments according to this aspect of the disclosure, the power source is at least one of a power cord adapted to plug into a standard alternating current outlet, a jack adapted to plug into a cigarette-lighter type receptacle in a car, clips adapted to attach to posts of a car battery, and a battery.
(9) According to another aspect of the disclosure, there is described a method for bleeding a hydraulic system using the apparatus of claim **1**, by connecting the first tube between the check valve and the bleeder valve, starting the vacuum pump, opening the check valve, opening the bleeder valve, monitoring the second tube for air entrainment in the hydraulic fluid, and when no air entrainment is seen in the hydraulic fluid, closing the bleeder valve and closing the check valve.
(10) In some embodiments according to this aspect of the disclosure, the check valve is closed prior to closing the bleeder valve. In some embodiments, the bleeder valve is opened prior to opening the check valve. In some embodiments, a fluid supply reservoir for the hydraulic system is maintained as needed in a filled capacity while the second tube is monitored for air entrainment.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) Further advantages are apparent by reference to the detailed description when considered in conjunction with the figures, which are not to scale so as to more clearly show the details, wherein

like reference numbers indicate like elements throughout the several views, and wherein:
(2) FIG. **1** is a functional block diagram of a system according to an embodiment of the present disclosure.
(3) FIG. **2** is a flow chart of a method for using the system of FIG. **1**, according to an embodiment of the present disclosure.

DESCRIPTION

(4) With reference now to the drawings, there are depicted all of the claimed elements of the various embodiments, although all claimed embodiments might not be depicted in a single drawing. Thus, it is appreciated that not all embodiments include all of the elements as depicted, and that some embodiments include different combinations of the depicted elements. It is further appreciated that the various elements can all have many different configurations, and are not limited to just the configuration of a given element as depicted. As indicated above, the elements of the drawings as depicted are not to scale, even with respect one to another, and relative size or thickness of one element cannot be determined by the aspect ratios of that element or with reference to any dimension of another element.

(5) With reference now to FIG. **1**, there is depicted one embodiment of a functional block diagram of the vacuum assisted line bleeding system **122** as connected to a fluid-driven hydraulic system **120**. In this particular example, it is convenient to assume that the hydraulic system **120** is a braking system, such as for a car, so that specifics in regard to the process and apparatus can be described, which tends to make the application of the bleeding system **122** to other hydraulic systems **120** more clear as well.

(6) This embodiment **100** depicts both the hydraulic system **120** and the bleeder system **122**. It is understood that the hydraulic system **120** could have many different configurations, but a basic configuration is diagrammatically depicted as hydraulic system **120** in FIG. **1**. In this embodiment, hydraulic system **120** includes a fluid supply reservoir **102**, a pump **104**, hoses **106** that connect the pump **104** to the operative assembly **108**, and a bleeder valve **110**. The hydraulic system **120** also includes, in some configurations, hoses or other such fluid conveyance means for the hydraulic fluid in the supply reservoir **102** to get to the pump **104**.

(7) In the example of a brake system for a car, the hydraulic system **120** includes a supply reservoir **102** that is typically disposed in the engine compartment under the hood of the car. The pumping system **104** typically includes a brake pedal that is operated by the driver from within the passenger compartment of the car, which brake pedal operates in association with a master cylinder to force the hydraulic fluid (in this example, brake fluid) through the hoses **106** (brake lines). The hoses **106** are connected to what has generically been referred to as an operative assembly **108**, which in the example of car brakes includes at least one of a disk brake caliper or a drum brake caliper. Each such operative assembly **108** has a bleeder valve **110**, which can be selectively opened or closed as desired, to either allow the hydraulic fluid to remain within the operative assemblies **108** or to allow the hydraulic fluid, and any air bubbles entrained therein, to flow out of the operative assemblies **108**.

(8) In the embodiment **100** as depicted, the bleeder valve **110** of the hydraulic system **120** is connected to the check valve **112** of the bleeder system **122**, such as with a tube that is at least partially transparent, so that a visual inspection of the contents of the tube can be made. For example, in the embodiment as described herein, it is beneficial for the operator to be able to visually confirm if the tube between the bleeder valve **110** of the hydraulic system **120** and the check valve **112** of the bleeder system **122** contains a flow of air only, hydraulic fluid only, or a mixture of both air and hydraulic fluid.

(9) The check valve **112** of the bleeder system **122** is connected to a fluid recovery reservoir **114**, again such as by a tube, into which air, hydraulic fluid, and a combination thereof can flow. The fluid recovery reservoir **114** is in fluid communication with a vacuum pump **116**, but in this case it is expected that no liquid would flow between the fluid recovery reservoir **114** and the vacuum

pump **116**. Instead, the vacuum pump **116** would draw a vacuum on the fluid recovery reservoir **114**. By so doing, when both the check valve **112** and the bleeder valve **110** are open, the vacuum pump **116** will draw hydraulic fluid (and possibly some amount of entrained air) from the fluid supply reservoir **102**, and through the other elements of the hydraulic system **120** as described above.

(10) A power source **118** is connected to the vacuum pump **116**, so as to provide power, such as electrical power, for the selective operation of the vacuum pump **116**. In various embodiments, the power source **118** can be at least one of a power cord for plugging into a standard alternating current outlet, a jack for plugging into a cigarette-lighter type receptacle in a car, clips for attaching to the posts of a car battery, and one or more batteries, such as rechargeable batteries. Other types of power sources are also comprehended herein.

(11) In some embodiments, all of the elements of the bleeder system **122** are provided as a portable kit, such as in a box with a handle, such as an ammo-type plastic box.

(12) With reference now to FIG. **2**, there is depicted a method **200** for one embodiment for the use and operation of the bleeder system **122**, with continued reference to the example of a car braking system. As given in block **202**, the fluid supply reservoir is filled to an appropriate level with the hydraulic fluid (brake fluid), and the bleeder valve **110** is connected with a tube to the check valve **112**, as given in block **204**. The vacuum pump **116** is then started, as given in block **206**. The check valve **112** and the bleeder valve **110** are opened as given in blocks **208** and **210**, which can be done in either order, meaning that either check valve **112** can be opened first or the bleeder valve **110** can be opened first.

(13) In some embodiments, the operative assembly **108** needs to be worked to start the hydraulic fluid flowing through the hydraulic system **120** under the influence of the vacuum provided by the vacuum pump **116**, as given in block **212**. In other embodiments, the hydraulic fluid will begin flowing through the hydraulic system **120** as soon as the second of the check valve **112** and the bleeder valve **110** is opened.

(14) At least one of the tube between the check valve **112** and the fluid recovery reservoir **114** and the fluid recovery reservoir **114** itself is monitored by the operator, as given in block **216**. At some point, hydraulic fluid will be visible in the tube and then in the fluid recovery reservoir **114**. At first, there is typically some amount of air present in the hydraulic fluid, which could manifest as either relatively larger gaps of air between plug-flows of hydraulic fluid or relatively smaller bubble of air entrained within the flow of hydraulic fluid. As more fluid flows into the fluid recovery reservoir **114**, the degree of air entrainment will decrease, until such point that it disappears entirely, and the bleeding operation has been successful.

(15) While this step **216** is occurring, the operator might want to also monitor the supply reservoir **102** to ensure that the supply reservoir **102** is not underflowing and aspirating air into the hydraulic system **120**, as given in block **214**. Additional hydraulic fluid can be added to the hydraulic system **120** in the supply reservoir **102** by the operator as needed or desired.

(16) Once the operator determines that a successful bleed of the hydraulic system **120** has occurred, the bleeder valve **110** and the check valve **112** are closed, as given in blocks **218** and **220**. As before, the order in which the bleeder valve **110** and the check valve **112** are closed is left to the operator, and either can be closed before the other, as desired.

(17) The method **200** is completed by removing the hose between the bleeder valve **110** and the check valve **112**, removing the bleeder system **122** from power, cleaning the hydraulic fluid from the various elements of the bleeder system **122** as desired, all as given in block **222** of the method **200**. In one embodiment, the vacuum pump **116** is left running, the tube is disconnected at the bleeder valve **110**, the check valve **112** is opened, and the hydraulic fluid within the tube is pulled into the fluid recovery reservoir **114** for reuse or disposal.

(18) One of the benefits of the method and apparatus as described above is that only a single operator is needed to bleed the hydraulic system **120**, by monitoring the level of hydraulic fluid in

the supply reservoir **202** and the air entrainment of the hydraulic fluid in the hose or recovery reservoir **114**.

(19) In one embodiment, the apparatus comes as a self-contained kit with removable hardware, comprised of the following: 11.6 in (L)×5.1 in (W)×7.1 in (H) heavy gauge polypropylene housing (with handle) that is water resistant and lockable 12 VDC mini vacuum pump mounted inside the housing AC/DC power plug 120 VAC/12 VDC power supply On/Off switch Air vent grill cover (metal) Fluid shutoff switch (1) 12 or 16 oz fluid recovery bottle (with two caps).Math. ¼″ hose barb (mounted to housing).Math. Approximately 4.5 ft of ¼″ clear PVC tubing

(20) As used herein, the phrase “at least one of A, B, and C” means all possible combinations of none or multiple instances of each of A, B, and C, but at least one A, or one B, or one C. For example, and without limitation: Ax1, Ax2+Bx1, Cx2, Ax1+Bx1+Cx1, Ax7+Bx12+Cx113. It does not mean Ax0+Bx0+Cx0.

(21) The foregoing description of embodiments has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the embodiments to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments are chosen and described in an effort to provide illustrations of their principles and practical applications, and to thereby enable one of ordinary skill in the art to utilize the embodiments with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

Claims

1. A bleeder system comprising: a check valve adapted to selectively enable or inhibit fluid communication, a first tube adapted to provide fluid communication between the check valve and a bleeder valve of a hydraulic system, a fluid recovery reservoir adapted to receive at least one of air and hydraulic fluid, a second tube connected between the check valve and the fluid recovery reservoir and adapted to provide fluid communication between the check valve and the fluid recovery reservoir, a vacuum pump adapted to selectively draw a vacuum, a third tube connected between the vacuum pump and the fluid recovery reservoir and adapted to provide the vacuum from the vacuum pump to the fluid recovery reservoir, and a power source adapted to provide power to the vacuum pump.
2. The bleeder system of claim 1, wherein the power source is at least one of a power cord adapted to plug into a standard alternating current outlet, a jack adapted to plug into a cigarette-lighter type receptacle in a car, clips adapted to attach to posts of a car battery, and a battery.
3. A method for bleeding a hydraulic system using the apparatus of claim 1, the method comprising the steps of: connecting the first tube between the check valve and the bleeder valve, starting the vacuum pump, opening the check valve, opening the bleeder valve, monitoring the second tube for air entrainment in the hydraulic fluid, when no air entrainment is seen in the hydraulic fluid, closing the bleeder valve, and closing the check valve.
4. The method of claim 3, wherein the check valve is closed prior to closing the bleeder valve.
5. The method of claim 3, wherein the bleeder valve is opened prior to opening the check valve.
6. The method of claim 3, wherein a fluid supply reservoir for the hydraulic system is maintained as needed in a filled capacity while the second tube is monitored for air entrainment.