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INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE

Abstract

An assembly for enabling continuous seat post function during extreme conditions is described and includes: a first valve at least partially, slidably disposed within a stationary piston and for controlling a first fluid pathway there through, wherein the first fluid pathway runs from a first portion and to a second portion of the oil chamber, wherein the stationary piston separates the oil chamber into the first portion and the second portion; and a second valve at least partially disposed within the stationary piston and disposed in series with the first valve and having a second fluid pathway disposed through the first valve and the second valve, being in parallel with the first fluid pathway, running from the first portion to the second portion of the oil chamber, and providing a bypass for oil to flow from the first portion to the second portion when the first fluid pathway is closed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This patent application is a continuation application of and claims the benefit of co-pending U.S. patent application Ser. No. 18/443,067, filed Feb. 15, 2024, entitled, “INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE”, by Barna Madau et al. having Attorney Docket No. FOX-P9-15-15-US.CON4, assigned to the assignee of the present application, which is incorporated herein in its entirety by reference thereto. [0002] The patent application Ser. No. 18/443,067 is a continuation application of and claims the benefit of U.S. patent application Ser. No. 17/401,116, filed Aug. 12, 2021, now U.S. Pat. No. 11,904,966, entitled, “INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE”, by Barna Madau et al. having Attorney Docket No. FOX-P9-15-15-US.CON3, assigned to the assignee of the present application, which is incorporated herein in its entirety by reference thereto. [0003] The patent application Ser. No. 17/401,116 is a continuation application of and claims the benefit of U.S. patent application Ser. No. 16/580,621, filed Sep. 24, 2019, now U.S. Pat. No. 11,091,215, entitled, “INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE”, by Barna Madau et al. having Attorney Docket No. FOX-P9-15-15-US.CON2, assigned to the assignee of the present application, which is incorporated herein in its entirety by reference thereto. [0004] The patent application Ser. No. 16/580,621 is a continuation application of and claims the benefit of U.S. patent application Ser. No. 15/944,584, filed Apr. 3, 2018, now U.S. Pat. No. 10,427,741, entitled, “INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE”, by Barna Madau et al. having Attorney Docket No. FOX-P9-15-15-US.CON, assigned to the assignee of the present application, which is incorporated herein in its entirety by reference thereto. [0005] The patent application Ser. No. 15/944,584 is a continuation application of and claims the benefit of U.S. patent application Ser. No. 14/887,126, filed Oct. 19, 2015, Now U.S. Patent No. 9,963,181, entitled, “INFINITE ADJUST SEAT POST WITH PRESSURE RELIEF VALVE”, by Barna Madau et al. having Attorney Docket No. FOX-P9-15-15-US, assigned to the assignee of the present application, which is incorporated herein in its entirety by reference thereto.

BACKGROUND

Field of the Invention

[0006] Embodiments generally relate to a seat support assembly for a vehicle. More specifically, embodiments of the invention relate to a height adjustable seat support.

Description of the Related Art

[0007] A conventional seat post for a bicycle includes a suspension system that comprises an upper

post telescopically positioned within a lower post. Within the upper and lower posts are positioned at least an oil chamber and a gas chamber sealingly separated by an internal floating piston (IFP). The conventional suspension system further may include an adjustable piston rod connected to a main piston, wherein the main piston divides the oil chamber into portion "A", that portion of the oil chamber closest to the seat saddle, and portion "B", that portion of the oil chamber closest to the gas chamber. These conventional seat posts are adjustable upon the actuation of a lever mechanically and/or remotely connected with the piston rod. The movement of the piston rod ultimately results in the opening and closing of flow ports within the main piston.

[0008] During times of extreme conditions (e.g., high temperatures, sudden changes in terrain, etc.), the portion "A" of the oil chamber furthest away from the IFP may experience an increase in pressure that causes a condition commonly known as hydrostatic lock. The term, "hydrostatic lock", generally is understood to describe a condition in a suspension in which a volume of an incompressible fluid exceeds its maximum available volume in which it resides; such a condition may render surrounding components at least temporarily non-functional.

[0009] Therefore a need exists for a seat post that avoids hydrostatic lock conditions during extreme conditions.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0010] The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the present technology for a seat post, and, together with the description, serve to explain the principles discussed below:

[0011] FIG. 1A depicts a conventional seat post, having a suspension system that supports a saddle thereon.

[0012] FIG. 1B depicts a block diagram of the conventional suspension system of FIG. 1A.

[0013] FIG. 2 depicts a conventional suspension system, including an upper and lower post.

[0014] FIG. 3 depicts a conventional top mount lever for mechanical connection to the piston rod.

[0015] FIG. 4 depicts a conventional under mount lever for remote connection to the piston rod.

[0016] FIG. 5 depicts a conventional external adjustment mechanism disposed on a lower post.

[0017] FIG. 6 depicts an infinite adjust seat post with a pressure relief valve, in accordance with an embodiment.

[0018] FIG. 7 depicts the first portion and the second portion of the infinite adjust seat post of FIG. 6, including the pressure relief valve, in accordance with an embodiment.

[0019] FIG. 8 depicts an enlarged view of the first portion of the infinite adjust seat post of FIG. 7, in accordance with an embodiment.

[0020] FIG. 9 depicts an infinite adjust seat post with a pressure relief valve, having an actuation assembly disposed external to the seat post, in accordance with an embodiment.

[0021] FIG. 10. depicts the components associated with the upper post and the lower post of the infinite adjust seat post, analogous to the upper and lower posts of FIGS. 6-9, in accordance with an embodiment.

[0022] FIG. 11 depicts an exploded view of the upper post and portions of the piston assembly that is inserted into the upper post, in accordance with an embodiment.

[0023] FIG. 12 depicts the cross section of the piston assembly of FIG. 11, assembled, in accordance with an embodiment.

[0024] FIG. 13 depicts an exploded view of the piston assembly of FIGS. 11 and 12, in accordance with an embodiment.

[0025] FIG. 14 depicts an exploded view of the upper post and the lower post, similar to that view shown in FIG. 10, but including an external adjustment mechanism, in accordance with an

embodiment.

[0026] FIG. **15** depicts an exploded view of the pressure relief valve of FIG. **13**, in accordance with an embodiment.

[0027] FIG. **16** depicts a cross sectional view of the pressure relief valve of FIG. **15**, in accordance with an embodiment.

DESCRIPTION OF EMBODIMENTS

[0028] Reference will now be made in detail to embodiments of the present technology, examples of which are illustrated in the accompanying drawings. While the technology will be described in conjunction with various embodiment(s), it will be understood that they are not intended to limit the present technology to these embodiments. On the contrary, the present technology is applicable to alternative embodiments, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

[0029] Furthermore, in the following description of embodiments, numerous specific details are set forth in order to provide a thorough understanding of the present technology. However, the present technology may be practiced without these specific details. In other instances, well known methods, procedures, and components have not been described in detail as not to unnecessarily obscure aspects of the present disclosure.

[0030] The following discussion will first describe conventional seat post technology, and the limitations associated therewith, with reference to FIGS. **1A-5**. The discussion then turns to a description of an infinite adjust seat post with a pressure relief valve, in accordance with an embodiment and with reference to FIGS. **6-16**.

[0031] With reference to FIG. **1A**, a conventional seat post is shown, having a conventional suspension assembly within a suspension system **100** that supports a saddle **125** thereon and comprises an upper post **105** (at a first end **115**) telescopically positioned within a lower post **110** (at a second end **120**). With reference to FIG. **1B**, a block diagram of a portion **105**, in the upper post **105**, of the conventional suspension system **100** is shown. Within the upper post **105**, is the upper post **112** telescopically positioned with a lower post **114**. Within the upper post **112** and the lower post **114** is an internal floating piston (IFP) **155** that sealingly separates an oil chamber **180** and a gas chamber **160** positioned therein. A main piston **175**, with flow ports A **140** and flow ports B **145** there through, separates the oil chamber **180** into portion "A" **130** and portion "B" **150**. Portion "A" **130** is that portion of the oil chamber **180** that is closest to the saddle **125**. Portion "B" **150** is that portion of the oil chamber **180** closest to the gas chamber **160**. Further, a first end of an adjustable piston rod **170** connects with an actuation assembly **205** (FIG. **2**) located at and external to the second end **120** of the suspension system **100**. The second and opposite end of the piston rod **170** extends in length to connect with the main piston **175**. One end of a spool valve **190** is positioned partially within the main piston **175** and is also positioned to receive the second end of the piston rod **170** upon movement of the piston rod **170**. When the piston rod **170** is adjusted via the actuation assembly **165**, it pushes against the spool valve **190**, which in turn slides up and away from the direction of the IFP **155**. The seals **135A** and **135B** on the outer walls of the spool valve **190** slide over flow port A **140** gaps in the walls of the main piston **175**, thereby leaving open these flow ports A **140**, and thereby allowing fluid to flow there through from the portion "A" **130** to the portion "B" **150**.

[0032] These conventional suspension assemblies **100** are adjustable upon the actuation of an actuation assembly **205** at the second end **120** of the suspension system **100**, shown at FIG. **2**. The piston rod **170** is communicatively coupled with the actuation assembly **205** via a cable or through the use of remote technologies common in the field of technology. FIG. **3** shows a top mount lever **300** that may be attached to the bicycle handle bars and also be mechanically attached to the actuation assembly **205** via a cable. FIG. **4** shows an under mount lever **400** that may be attached to the bicycle handle bars and communicatively and remotely coupled with the piston rod **170** or the actuation assembly **205** through remote technologies commonly known in the art. FIG. **5** shows an

example of an external adjustment mechanism **500** that is used to adjust the piston rod **170** and/or to adjust the spool valve **190**. The movement of the piston rod **170**, and hence the spool valve **190**, ultimately results in the opening and closing of flow ports A **140** within the main piston **175**.

[0033] As noted, when the flow ports A **140** in the main piston **175** are open, if the oil from portion “B” may flow through the main piston **175** and into portion “A” **130**, then the upper post **105** of the suspension system **100** extends and raises the saddle **125** attached to the suspension system **100**. If force is applied to the suspension system **100**, such as by the rider sitting on the saddle **125**, and the flow ports A **140** remain open, then oil flows from the portion “A” **130**, through the main piston **175**, and into the portion “B” **150**. Such flow is slowed and/or stopped when: 1) the flow ports A **140** are subsequently closed (through an actuation of a mechanical or remote lever); or 2) when fluid pressure (via the oil) that is applied against a first side of the IFP **155** (that divides the oil chamber **180** and the gas chamber **160**) is met by an equal or greater pressure applied against a second side of the IFP **155** by the gas within the gas chamber **160**, wherein the second side of the IFP **155** is opposite the first side of the IFP **155**.

[0034] Thus, as seen, the conventional mechanical and/or remotely connected lever is designed, upon actuation, to move the piston rod **170**. The movement of the piston rod **170** moves the spool valve **190**. The movement of the spool valve **190**, the sliding up and down within the main piston **175**, opens or closes flow ports A **140**, respectively, within the main piston **175**. The opened and closed flow ports A **140** causes the volume of oil within the oil chamber **180** to shift between the portion “A” **130** and the portion “B” **150**. The shifting of the oil, from one chamber of oil to another chamber of oil, causes the suspension system **100** to expand or compress. The expansion or compression of the suspension system **100** causes the saddle **125** resting upon the suspension system **100** to move up or down, respectively.

[0035] In the situation in which the flow ports A **140** within the main piston **175** are closed, and the temperature internal to the suspension system **100** increases correspondingly to the temperature external to the suspension system **100**, then the oil within the portion “A” **130** and portion “B” **150** also thermally expands. The thermally expanded oil within the portion “B” **150** increases in volume and pressing against and moves the IFP **155** in the direction of the gas chamber **160**, thereby making the gas chamber **160** smaller while enlarging the portion “B” **150**. However, the thermally expanded oil within the portion “A” **130** does not increase in volume since this oil presses against sliding **185** and sealing **135A** and **135B** elements that serve as valves (gates) through the flow paths A **140** of the main piston **175**, keeping them from opening and creating more volume. As previously noted, in one instance, a lever mechanically or remotely, upon actuation, causes the piston rod **170** to move and thereby moves the adjacent spool valve **190**. The spool valve **190** movement translates into sliding up and down within the main piston **175**. The walls of the spool valve **190** are made of “sliders” **185** and have seals extending there from and are attached thereto. When in the “open” position, the seals **135B** are positioned on one side of the flow ports A **140**, toward the saddle **125** direction. While in the open position, the flow pathway A **140** remains unblocked. While in the “closed” position, the seals **135B** are positioned on the other side of the flow ports A **140**, toward the gas chamber **160** direction. While in the closed position, the flow pathway after entering and exiting the flow port A **140** remains blocked by the seals **135B**, such that oil may not pass there through (within the main piston **175**) from the portion “A” **130** to the portion “B” **150**.

[0036] At some point, the increase in the pressure within the portion “A” **130** of the oil chamber **180** becomes so great that the lever (e.g., the top mount lever **300** of FIG. 3) that is connected to the piston rod **170** cannot be pushed down (without extreme force) to cause the piston rod **170** to move. Since the piston rod **170** cannot be moved, the spool valve **190** cannot be moved, and the seals **135B** extending from the slider **185** of the spool valve **190** remain in place and continue to block the flow pathway A **140**. Since oil is unable to flow from the portion “A” **130** to the portion “B” **150** and vice versa, the suspension system **100** succumbs to what is commonly known as

hydrostatic lock, wherein the suspension system **100** cannot compress or expand upon actuation of a lever.

[0037] As the foregoing illustrates, what is needed in the art are improved techniques for adjusting seat post heights while avoiding and/or overcoming a potential hydrostatic lock situation.

Example Infinite Adjust Seat Post With Pressure Relief Valve

[0038] Embodiments of the present technology provide for an infinite adjust seat post with a pressure relief valve that prevents and eliminates hydrostatic lock by using the increase in pressure, which would normally occur in situations producing hydrostatic lock, to open a pressure relief valve. The pressure relief valve is strategically positioned in series with a spool valve, taking advantage of the fluid channel disposed within the spool valve to transfer oil from one side of the main piston to the other side of the main piston. These concepts will be discussed herein.

[0039] Additionally and as will be explained below, the infinite adjust seat post provides for two parallel pathways, each having a different entry point in the main piston, but the same destination. Together, the two pathways function to allow fluid to move from a portion “A” to a portion “B” of the oil chamber. Separately, each flow pathway receives fluid flow non-concurrently.

[0040] FIG. **6** depicts an infinite adjust seat post **600** with a pressure relief valve **835**, in accordance with an embodiment. More particularly, FIG. **6** shows an upper post **690** telescopically positioned within a lower post **670**. The actuation assembly **660** is shown connected to the second end **650** of the infinite adjust seat post **600**, at the lower post **670**. The actuation assembly **660** includes a set of components (e.g., wire, metal tabs) that function together to, upon actuation, move the piston rod **630** either in a first direction or in an opposite second direction. Interior to the inner walls of the upper and the lower posts, **690** and **670**, respectively, are an oil chamber **615** and a gas chamber **645**. The IFP **635** separates the oil chamber **615** from the gas chamber **645**, and provides a seal there between. Further, the main piston **625** separates the oil chamber into portion “A” **695** and portion “B” **620**. Portion “A” **695** is positioned closest to the saddle and portion “B” **620** is positioned opposite portion “A”, at the other end of the oil chamber **615**.

[0041] The main piston **625** has flow ports A **705** and flow ports B **710** (FIGS. **7** and **8**) disposed therein that enable oil to flow from the portion “A” **695** to the portion “B” **620** and vice versa. The first end **665** of the piston rod **630** connects with the actuation assembly **660**, while the second end **675** of the piston rod **630** connects with and resides within the main piston **625**. More particularly, the main piston **625** provides a guided slot **725** (FIG. **7**) central thereto and there through that allows for the movement of the piston rod **630** back and forth therein. The second end **675** of the piston rod **630**, upon its movement in a direction toward the main piston **625**, butts up against and pushes on a first end of the spool valve **680**. The walls of the spool valve **680**, called sliders **815** (functioning to slide back and forth within the main piston **625**) (FIG. **8**), have extensions thereon, called seals **820** (FIG. **8**). These seals **820** fit snugly against the inner walls of the main piston **625**, such that fluid may not flow through or around the seals **820**. Upon being pushed at its first end, the spool valve **680** slides in a direction that is toward the portion “A” **695** of the oil chamber **615**, opening up flow ports B **710** (FIGS. **7** and **8**) disposed within the main piston **625**, thereby allowing oil to flow there through. A pressure relief valve **835** is shown, disposed in series with the spool valve **680**, disposed partially within the interior of the main piston **625**, and disposed partially within the portion “A” **695** side of the main piston **625**.

[0042] FIG. **7** depicts the first portion **610** and the second portion **640** of the infinite adjust seat post **600** of FIG. **6**, including the pressure relief valve **835**. However, in order to exhibit a higher degree of detail, the middle portion of the infinite adjust seat post **600** of FIG. **6** has been redacted. Shown in FIG. **7** is the upper post **690** telescopically disposed within the lower post **670**. The actuation assembly **715** is positioned at the second end **650** of the infinite adjust seat post **600**, at the lower post **670**. The IFP **635** separates the gas chamber **645** from the oil chamber **615**. The oil chamber **615** is divided into the portion “A” **695** and the portion “B” **620** by the main piston **625** there between. The main piston **625** has flow ports A **705** and flow ports B **710** disposed therein.

The pressure relief valve **835** and the spool valve **680** are shown positioned in series with each other and also partially positioned within the main piston **625**. The first end **665** of the piston rod **630** is shown connected to the actuation assembly **715** and the second end **675** of the piston rod **630** is shown disposed within the guided slot **725** of the main piston **625**. Additionally, anti-rotation pins **720** are shown. As positioned, these anti-rotation pins **720** prevent the upper post **690** from rotating circularly within the lower post **670**.

[0043] FIG. **8** depicts an enlarged view of the first portion **610** of the infinite adjust seat post **600** of FIG. **7**, in accordance with an embodiment. The flow ports A **705** and flow ports B **710** within the main piston **625** and the flow pathways A **825** within the upper post **690** are more clearly visible and will be described below. Again, the piston rod **630** is shown connected within the guided slot **725** of the main piston **625**. Disposed within the walls of the main piston **625** are flow ports A **705** and flow ports B **710**. Flow pathway A **825** is also shown, traveling from the portion “A” **695** of the oil chamber **615**, into and out of the flow ports A **705**, into the interior of the main piston **625**, into and out of the flow ports B **710**, and then into the portion “B” **620** of the oil chamber **615**. Further, in other embodiments, the flow pathway A **825** is reversed. Also shown, in FIG. **8** is the pressure relief valve **835** and the spool valve **680**. The outer walls of the spool valve **680** include the sliders **815** and the seals **820** extending from the sliders **815**. The pressure relief valve **835** includes the ball **805** and the spring **810**. Flow pathway B **830** is shown, traveling from the portion “A” **695** of the oil chamber **615**, into and through the gap **845** left by the ball **805** being pushed against the spring by the pressurized oil, into the interior of the main piston **625**, into and out of the flow ports B **710**, and into the portion “B” **620** of the oil chamber **615**.

[0044] With reference to FIG. **8**, the effects of thermally expanded oil within the oil chamber **615** and the application of the pressure relief valve **835** to prevent hydrostatic lock of the infinite adjust seat post **600** is now explained. In this case, the pressure relief valve **835** of the infinite adjust seat post **600** provides for the release (and relief) of the build-up of pressure within the portion “A” **695** of the oil chamber **615**, due to, in some embodiments, the thermal expansion of the oil. In one example, initially, the slider **815** and the seal **820** of the spool valve **680** are positioned on the saddle side of the flow ports A **705**. (Not shown; of note, FIG. **8** shows the seal **820** positioned to one side of the flow ports A **705**, toward the direction of the gas chamber.) In this position, oil from the portion “A” **695** of the oil chamber **605** is allowed to travel along the flow pathways A **705**, from the portion “A” **695**, into and out of the flow ports A **705**, through the interior of the main piston **625**, into and out of the flow ports B **710**, and into the portion “B” **620**, and vice versa.

[0045] Situations in which the flow ports A **705** would be “open” include at least the following scenarios: 1) when no force is being applied against the saddle; and 2) when the second end **675** of the piston rod **630** is pushing against the spool valve **680**, and in which the spool valve **680** is pushed in the direction toward the saddle, thereby leaving flow ports A **705** open.

[0046] Situations in which the flow ports A **705** would be “closed”, and could cause hydrostatic lock include at least the following scenarios: 1) the piston rod **630** is not actuated to push against the spool valve **680** and much force is being continuously applied to the saddle; 2) the piston rod **630** is not actuated to push against the spool valve **680** (in the direction toward the saddle), and the bicycle goes over a large unexpected bump, driving the rider further onto the saddle during impact with the ground, causing the upper piston **850** to push against the upper part of the spool valve **680** during compression. The spool valve **680** then slides downward in the direction toward the gas chamber, and its seals block the flow pathways A **825**; and 3) during thermal expansion of the oil, the volume within the portion “A” **695** of the oil chamber **615** cannot expand into the portion “B” **620**, since the initial thermal expansion of the oil in portion “A” **695** causes the spool valve **680** to be pushed downwards toward the gas chamber, thereby blocking the flow pathways A **825**.

[0047] FIG. **8** depicts the pressure relief valve **835**, which functions to release the pressure being applied against the seals **820** (when the seals **820** are in the position shown in FIG. **8** [on one side of the flow ports A **705**, in the direction of the gas chamber, blocking the flow pathways A **825**),

and eliminate the possibility of hydrostatic lock from occurring. The pressure relief valve **835** includes an annular wall **840**, surrounding a ball **805** that sits on top of a spring **810**. The spring **810** comprises a predetermined spring pressure. When a particular amount of pressure is applied against the ball **805**, the ball **805** pushes downward against the spring **810**, overcoming the spring force. Thus, when the oil is pressurized to a higher degree than the spring **810** holding the ball **805**, then the ball **805** pushes the spring **810** downwards and exposes the gap **845** through which pressurized oil may flow. This pressurized oil flows along the flow pathway B **830**. Just enough pressurized oil flows through the gap **845** and past the ball **805** to lower the amount of pressure being experienced by the oil remaining in the portion “A” **695** of the oil chamber **615**. When oil is pressurized and applies force to the ball **805** that is a degree lower than the force applied on the opposite side of the ball **805** from the spring (having a particular spring constant), then the force being applied against the ball **805** is not enough to overcome the spring constant and push the spring **810** downwards.

[0048] However, by opening up the gap **845** to allow for some pressurized oil to flow through, the amount of oil left in the portion “A” **695** is less than was there before, while the area remains the same, thus increasing the volume for the oil that is left. Thus, by the formula, $PV=nRT$, it can be seen that as the volume increases, the pressure decreases (given a constant temperature). Thus, the pressure that is holding the seals **820** in the position that blocks the flow pathway A **825** is reduced. It is reduced enough to enable the piston rod **630** to move the spool valve **680** against the remaining pressure being applied to the seal **820**. Thus, after the pressure relief valve **835** opens up, thereby reducing the pressure within the oil remaining in the portion “A” **695** and also reducing the force being applied against the seal **820**, that was holding the spool valve **680** in place, the bicycle rider is now able to physically pull or push the lever and actuate the piston rod **630** (causing the piston rod **630** to move).

[0049] As can be seen, the present technology uses the increased pressure caused by a hydrostatic lock scenario to its benefit, harnessing this pressure to actuate the pressure relief valve **835**. Upon actuation, the pressure relief valve **835** opens to let pressurized oil flow from the over-pressurized volume of the portion “A” **695** and into the expandable volume of the portion “B” **620**. Such an innovative process provides for a hydrostatic lock-free existence, regardless of the riding scenario.

[0050] In conventional designs, and without the pressure relieve valve **835**, the spool valve **680** would end up stuck in a hydrostatic lock position, blocking the flow of any oil from the portion “A” **695** to the portion “B” **620** of the oil chamber **615** through the flow paths A **825**. As noted herein, the pressure relief valve **835** is situated in series with the spool valve **680**, such that the flow pathway B **830** travels through both components before exiting the main piston **625** and entering the portion “B” **620** of the oil chamber **615**. Additionally, and significantly the two flow pathways, A **705** and B **710**, have different points of entry into the main piston **625**, but the same destination point. This is significant since the seal **820** blocking the origination point of the flow pathway B **830** is concurrently entering a hydrostatically locked position, while the pressure potentially causing the hydrostatically locked position is that which triggers the flow pathway B **830** to open, thereby alleviating or eliminating any pre-hydrostatic lock symptoms. As such, the infinite adjust seat post **600** with the pressure relief valve **835**, in accordance with embodiments, does not experience hydrostatic lock.

[0051] FIGS. **9-16** that follow are further figures that help detail various particularities regarding the infinite adjust seat post with a pressure relief valve, in accordance with various embodiments.

[0052] FIG. **9** depicts an infinite adjust seat post **600** with a pressure relief valve **835**, having an actuation assembly **660** being external to the infinite adjust seat post **600**, in accordance with an embodiment. In FIG. **9**, it is seen that the actuation assembly **660** is mounted at the second end **650** of the lower post **670**. FIG. **5** also offers another view of the externally mounted actuation assembly (such as seen in FIG. **5**). The actuation assembly **660** of FIGS. **6** and **9** functions to cause the spool valve **680** to slide back and forth (or up and down) within the main piston **625**, thereby opening and

closing, respectively, the flow pathway A **825**.

[0053] FIG. **10**. depicts the components associated with the upper post **690** and the lower post **670** of the infinite adjust seat post **600**, analogous to the upper and lower posts, **690** and **670**, respectively, of FIGS. **6-9**, in accordance with an embodiment. According to one embodiment, these components include, and are listed from the top of the depicted infinite adjust seat post to its bottom, the following: a seat post saddle clamp shaft cross pin; a forged upper saddle clamp, a forged lower saddle clamp; a washer fastener for a spherical saddle clamp; a seat post bolt with a conical under head features fastener; an upper post; a pin; a lower post; an internal wire retaining ring; a seat post rocker link; a Loctite; a seat post cable stop bottom cap; a SST dowel; an SS external shaft E-clip; a seat post cable bushing; a headed pin; and a seat post actuation lever.

[0054] FIG. **11** depicts an exploded view of the upper post **690** and portions of a piston assembly that is inserted into the upper post **690**, in accordance with an embodiment. The components of FIG. **11** are listed, as assembled, from the internal wire retaining ring on the left to the shaft lug on the right, as follows: an internal wire retaining ring; a seat post spool valve cap assembly; a piston assembly; an upper post; an internal wire retaining ring; a seat post IFP assembly; a wire retaining bore retaining ring; a seat post seal head; a ring; a seat post seal; a seat post upper bushing; a seat post lower bushing; and a shaft lug.

[0055] FIG. **12** depicts the cross section of the piston assembly of FIG. **11**, assembled, in accordance with an embodiment. FIG. **13** depicts an exploded view of the piston assembly of FIGS. **11** and **12**, in accordance with an embodiment. The components of FIG. **13** are listed, as assembled, from the seat post pressure relief valve on the left to the O-ring seals on the right, as follows: seat post pressure relief valve; seat post crush washer; spring music wire; seat post spool valve; seat post piston glide ring; seat post spool valve piston; O-ring; push rod; shaft; and O-ring seals.

[0056] FIG. **14** depicts an exploded view of the upper post **690** and the lower post **670**, similar to that view shown in FIG. **10**, though including an external adjustment mechanism, in accordance with an embodiment. The infinite adjust seat post of FIG. **14** further includes, beyond those components shown in FIG. **14**, the following components, as assembled, from the seat post cable actuation stop; the external retaining ring; the seat post bell crank shaft; the O-ring seals; the seat post pulley; and the flat-head socket cap screw.

[0057] FIG. **15** depicts an exploded view of the pressure relief valve **835** of FIG. **13**, in accordance with an embodiment. The components of FIG. **13** are listed in the order to be assembled, from the seat post spool valve cap to the pressure relief valve spring retainer, as follows: the spool valve cap; the steel ball; the detent spring; and the pressure relief valve spring retainer.

[0058] FIG. **16** depicts a cross sectional view of the pressure relief valve **835** of FIG. **15**, in accordance with an embodiment. Components shown in FIG. **16** include the ball **805** and the spring **810**.

[0059] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be implemented without departing from the scope of the invention, and the scope thereof is determined by the claims that follow.

Claims

1. An adjustable seat post comprising: a first post; a second post, wherein said first post and said second post are telescopically disposed with respect to each other; a piston disposed within said adjustable seat post; a first valve at least partially disposed within said piston, said first valve controlling a first fluid pathway for fluid through said piston, wherein said first fluid pathway extends between a first portion of a fluid chamber and a second portion of said fluid chamber; an internal floating piston disposed within said seat post, said internal floating piston disposed between said second portion of said fluid chamber and a gas chamber such that said internal

floating piston separates said gas chamber from said second portion of said fluid chamber; a second valve at least partially disposed within said piston, said second valve providing a second fluid pathway through said piston, wherein said second fluid pathway extends between said first portion of said fluid chamber and said second portion of said fluid chamber; and an actuation assembly, said actuation assembly for actuating said adjustable seat post.
