Claims

1. A hydraulic depth compensated actuator, suitable to form a part, for example, of a transportable inline depth compensated heave compensator for subsea lifting or loading operations, the hydraulic depth compensated actuator comprising:

an actuator, the actuator comprising

a first cylinder,

a second cylinder mounted concentric with the first cylinder, and connected to the first cylinder at an upper end of the first cylinder,

a ring piston configured to slide on the outer diameter of the second cylinder,

a hollow piston rod connected to the ring piston and configured to reciprocate inside the first cylinder, wherein the hollow piston rod comprises a tail surface configured to be exposed to external water pressure,

a first connection means and second connection means associated with the actuator such that first connection means is positioned at an axial end of the actuator and second connection means is positioned at an opposing axial end of the actuator, and

a plurality of actuator volumes configured to contain a gas or a liquid, the plurality of actuator volumes including

a first volume formed by an outer diameter surface of the hollow piston rod, a lower end surface of the first cylinder, an inner diameter surface of the first cylinder, and a lower end surface of the ring piston, wherein the first volume is configured to be filled with oil or gas,

a second volume formed by an outer diameter surface of the second cylinder, an upper end surface of the first cylinder, the inner diameter surface of the first cylinder, and an upper end surface of the ring piston, wherein the second volume is configured to be filled with oil or gas or under vacuum, and

a third volume formed by an inner diameter surface of the second cylinder, the upper end surface of the first cylinder, an inner diameter surface of the hollow piston rod, and a lower end surface of the hollow piston rod, wherein the third volume is configured to be filled with oil or gas or under vacuum; and

a depth compensator, the depth compensator comprising

a third cylinder,

a second piston,

a second piston rod extending out through an end closure of the depth compensator, wherein an end of the second piston rod is configured to be exposed to a surrounding water, and

a plurality of depth compensator volumes, the plurality of depth compensator volumes including

a fifth volume formed by a lower end surface of the third cylinder, an inner diameter surface of the third cylinder, a lower end surface of the second piston, and an outer diameter surface of the second piston rod, wherein the fifth volume is configured to be filled with gas or under vacuum, and

a sixth volume formed by an upper end surface of the third cylinder, the inner diameter surface of the third cylinder, and an upper end surface of the second piston, wherein the sixth volume is configured to be filled with oil; and

a conduit configured to connect the second volume in the actuator and the sixth volume in the depth compensator.

2. The hydraulic depth compensated actuator according to claim 1, wherein the hydraulic depth compensated actuator further comprises a depth compensator, the depth compensator comprising:

a first accumulator cylinder,

a second accumulator cylinder having a smaller diameter than the first accumulator cylinder, and concentrically arranged inside the first accumulator cylinder at one end of the first accumulator cylinder,

an accumulator piston configured to reciprocate inside the first accumulator cylinder, and dividing the first accumulator cylinder into a ninth volume at a side of the first accumulator piston and a tenth volume at an opposite side of the first accumulator piston, and

an accumulator piston rod fixed to and projecting out from the accumulator piston,

a second accumulator piston connected to an opposite end of the accumulator piston rod, wherein the second accumulator piston is positioned inside the second accumulator cylinder, and

a first conduit configured to establish fluid communication between the ninth volume and at least one of the plurality of actuator volumes,

a second conduit configured to establish fluid communication between the tenth volume and a separate one of the plurality of actuator volumes, and

a reversible pump configured to be positioned along the second conduit.