diaphragm and plug unit during closing of the valve. In further contrast to prior art hydraulic control valves, in which the signficant amount of control tubing has to be dismounted each time the valve cover is removed to inspect the diaphragm, the hydraulic control valve of the present invention may incorporate one or more internal control passages in the valve cover connecting the cocntrol tubing to the base of the valve. Removing the valve cover may not require moving the control equipment. In further contrast to the prior art, in which the valve cover cannot be conveniently installed both vertically and horizontally and be effective for air removal, in the hydraulic control valve of the present invention, both vertical and horizontal installation of the valve cover may be possible in a manner that allows positioning for the control mouth within the control chamber at a highest point for air removal. In still further contrast to the prior art, in which the valve seat may penetrate, damage and/or rust the coated surface of the valve bore undercut, the hydraulic control valve of the present invention has a snap seat sealed with an O-ring that may avoid this kind of damage or penetration. In still further contrast to the prior art, in which the indicators of the position of the diaphragm leak since they alternate from wet to dry locations and are subject to being covered with dirt which wears out the seal and/or the indicators are prone to bending from being struck since they may project out of the valve, the indicator of the valve of hydraulic control valve of the present invention is entirely inside the valve and does not move from wet to dry position. Hence, the indicator may not be subject to bending or leakage. In contrast to the prior art, in which the drain hubs may not be compatible with drain piping of a variety of systems that the valve be used for, the hydraulic control valve of the present invention has drain hubs with elbow fittings that can swivel to mate with system drain piping located in multiple positions and can control whether upstream and downstream sides of the valve may drain.

The principles and operation of an apparatus and method for a hydraulic control valve according to the present invention may be better understood with reference to the drawings and the accompanying description.

As seen in FIG. 1, the present invention may be described as a hydraulic control valve 100, comprising a valve cover 2 covering a valve body 1. Valve 100 also includes a diaphragm and plug unit 4. Valve body 1, diaphragm and plug unit 4 (including plug 66 and diaphragm 65) and valve cover ~~1~~ 2 may together be inclined relative to the flow channel of liquid, such as water. As can be seen from FIG. 1, valve inlet 5 can be called the "upstream" side of valve 100, and valve outlet 6 the "downstream" side of the valve 100. In comparing FIG. 1a1 with FIG. 1a2, it can readily be seen that diaphragm and plug unit 4, in a "closed" or "down" position, may block the flow channel from valve inlet 5 to valve outlet 6 and, as seen in FIG.

WHAT IS CLAIMED IS:

1. A hydraulic control valve, comprising:

a valve body at least partially defining a flow path from an inlet to an outlet;

a cover; and

a diaphragm ~~and plug unit, the diaphragm including a rim sealable by the cover and including an integral spring between the rim and the plug; and~~-and-plug unit comprising a rim sealable by the cover, a plug and a flexible diaphragm extending between the rim and the plug, said flexible diaphragm having a portion of a first thickness adjacent to said plug and a portion of a decreased thickness further from said plug,

~~a control chamber between the cover and the diaphragm and plug unit, the diaphragm and plug unit, in a down position, blocking a flow channel and in an up position unblocking the flow channel, the integral spring tapered so as to comprise a thinner portion further from the plug than a thicker portion, during a closing motion of the diaphragm and plug unit the thicker portion exerting a force to move the diaphragm and plug unit down in an initial motion and the thinner portion completing the closing motion by exerting a weaker force than the force exerted by the thicker portion.~~

wherein said cover and said diaphragm-and-plug unit together define a hydraulic control chamber, and wherein, in a closed position of said diaphragm-and-plug unit, said plug blocks said flow path and, in an open position of said diaphragm-and-plug unit, said plug is raised so as to unblock the flow path,

wherein said thickness of said flexible diaphragm is configured to provide a non-linear integral spring biasing said plug towards said closed position such that, during a closing motion of the diaphragm-and-plug unit from a fully-open position towards said closed position, said portion of said diaphragm adjacent to said plug exerts a first closure force to displace the plug from a fully-open position, and said portion of decreased thickness generates a second closure force weaker than said first force during a terminal part of the closing motion, thereby resulting in a non-linear variation of a mechanical closing force across at least part of the closing motion between a fully-open and

fully-closed position as a function of displacement of said diaphragm-and-plug unit,

the valve being configured so that at least a majority of the initial mechanical closing force acting to displace the diaphragm-and-plug unit from the fully-open position is supplied by the integral spring.

2. The hydraulic control valve of claim 1, wherein ~~as~~ the valve ~~closes, a closing force of the integral spring weakens faster than linearly in relation to a displacement of~~is configured such that substantially all of the initial mechanical closing force acting to displace the diaphragm ~~-~~-and ~~-~~-plug unit from the fully-open position is supplied by the integral spring.

3. The hydraulic control valve of claim 1, wherein in the ~~up~~fully-open position, the ~~spring~~flexible diaphragm is urged against the cover.

4. The hydraulic control valve of claim 1, wherein the plug is in a central portion of the diaphragm -and -plug unit.

5. The hydraulic control valve of claim 1, wherein ~~the thicker~~said portion ~~is~~of said first thickness circumscribes said plug adjacent to the plug and ~~the thinner~~said portion ~~is~~of reduced thickness circumscribes said plug adjacent the rim.

~~6. An indicator mechanism, comprising:~~

~~a position indicator that is dry; and~~

~~a mechanism that is wet, the mechanism including (a) a bracket moving in response to movement of a measured element and (b) a rotor that turns the position indicator, wherein the bracket converts a reciprocating movement of the bracket to a rotational movement of the rotor.~~

~~7. The assembly of claim 6, wherein the measured element is a plug in a valve and the position indicator indicates the position of the plug.~~

~~8. An assembly for an indicator, comprising:~~

~~a bracket having a sliding guide, the bracket capable of being positioned between a diaphragm position indicator and a plug; and~~

~~a helical rotor capable of being positioned so that a top portion of the helical rotor is associated with the diaphragm position indicator and so that movement of the plug rotates the helical rotor.~~

~~9. The assembly of claim 8, wherein the movement of the plug is an up and down movement.~~

~~10. The assembly of claim 8, wherein the top portion of the helical rotor is attached to the diaphragm position indicator by means of a rotor stem so that rotation of the helical rotor rotates the diaphragm position indicator.~~

~~11. An indicator mechanism, comprising:~~

~~a diaphragm position indicator;~~

~~a bracket having a sliding guide and situated between the diaphragm position indicator and a diaphragm and plug unit; and~~

~~a helical rotor whose top portion is associated with the diaphragm position indicator, wherein a movement of the diaphragm and plug unit rotates the helical rotor.~~

~~12. The indicator mechanism of claim 11, wherein the entire indicator mechanism is inside the valve.~~

~~13. The indicator mechanism of claim 11, wherein the movement of the diaphragm and plug unit is a reciprocating movement toward and away from the diaphragm position indicator.~~

~~14. The indicator mechanism of claim 11, wherein the diaphragm position indicator is a turning indicator.~~

~~15. The indicator mechanism of claim 11, wherein the indicator mechanism is for a hydraulic control valve that is a diaphragm or piston actuated valve.~~

~~16. The indicator mechanism of claim 11, wherein the bracket is situated in a control chamber between the diaphragm position indicator and the diaphragm and plug unit.~~

~~17. A snap seat for supporting a plug of a diaphragm and plug unit of a valve, comprising:~~

~~a flat annular seat portion; and~~

~~a grip skirt portion integrally joined to the seat portion at an acute angle, the grip skirt portion having a plurality of slots that divide the grip skirt portion into sections so that the snap seat snaps into place when the grip skirt portion is pressed against a body undercut of the valve.~~

~~18. The snap seat of claim 17, wherein the wall is a valve bore undercut.~~

~~19. The snap seat of claim 17, wherein the slot sections allow the sections of the grip skirt portion to expand when the grip skip portion is pressed against the wall.~~

~~20. The snap seat of claim 17, further including an O-ring that seals the snap seat to the wall at the angle between the seat portion and the grip skirt portion.~~

~~21. A valve and cover assembly comprising the hydraulic control valve of claim 1 and a cover for the hydraulic control valve, the hydraulic control valve having valve control equipment situated above the valve, the cover comprising:~~

~~a valve cover having an internal control passage in communication with a base of the valve, the passage sufficient to house valve control tubing and operatively engaged to the valve at a control boss on a body of the valve, the valve cover removable from a body of the valve without disconnecting the control equipment.~~

6. The hydraulic control valve of claim 1 configured to be controlled by fluid pressure within a pressurized fluid control line,

wherein said cover is formed with an internal control passage in communication with said hydraulic control chamber and terminating in an orifice oriented towards said valve body, and wherein said valve body is formed with a supplementary control passage deployed for fluid interconnection with said orifice and terminating in an externally accessible connection port for attachment of the pressurized fluid control line, such that when the pressurized fluid control line is connected to said connection port, said cover is removable from said valve body without disconnecting the pressurized fluid control line from said connection port.

7. The hydraulic control valve of claim 6, wherein said orifice is located outside said rim of said diaphragm.

8. The hydraulic control valve of claim 6, wherein said supplementary control passage is referred to as a first supplementary control passage, said orifice coming into fluid interconnection with said first supplementary control passage when said cover is attached to said valve body in a first orientation,

wherein said valve body is formed with a second supplementary control passage deployed for fluid interconnection with said orifice when said cover is attached to said valve body in a second orientation.

9. The hydraulic control valve of claim 8, wherein in said first orientation of said cover, an opening of said internal control passage into said control chamber is located in an upper portion of said control chamber when the hydraulic control valve is deployed with said flow path horizontal, and wherein in said second orientation of said cover, an opening of said internal control passage into said control chamber is located in an upper portion of said control chamber when the hydraulic control valve is deployed with said flow path vertically upwards.

10. The hydraulic control valve of claim 1, wherein said diaphragm gradually diminishes in thickness from adjacent the plug to adjacent the rim.

~~22. The valve and cover assembly of claim 21, wherein the internal control passage is outside of a control chamber of the valve.~~

~~23. The valve and cover assembly of claim 21, wherein the valve cover is operatively engaged to the valve body in at least one of two positions, in a first position the valve cover operatively engaged to the body control boss and in a second position of the valve cover that is 180 degrees from the first position the valve cover operatively engaged to a second body control boss.~~

~~24. The valve and cover assembly of claim 23, wherein in the first position a control mouth is at a highest point of the control chamber for horizontal installation of the cover and wherein in the second position the control mouth is at the highest point of the control chamber for vertical installation of the cover.~~