CLAIMS

What is claimed is:

1. A pressure regulator, comprising:

a pressure-balanced plug having openings from a first side to a second side so as to vent fluid from space on the first side to space on the second side;

a pneumatic actuator coupled with the pressure-balanced plug, the pneumatic actuator including a diaphragm;

a pilot unit disposed on the pneumatic actuator~~;~~, the pilot unit comprising a first pilot valve, an orifice, and a check valve; and

~~conduit coupling the pilot unit with the pneumatic actuator.~~

conduit coupling the pilot unit with the pneumatic actuator, the conduit including a first sense line coupling flow between a first side of the check valve on the first pilot valve and a first side of the diaphragm in the actuator, a second sense line coupling flow of fluid between a location downstream of said pressure regulator and the first side of the diaphragm in the actuator, and a load line coupling flow of fluid between a second side of the check valve on the first pilot valve and a second side of the diaphragm in the actuator.

2. The pressure regulator of claim 1, wherein the pressure-balanced plug comprises a first member and a second member that are separable from one another.

3. The pressure regulator of claim 1, wherein the pressure-balanced plug comprises ~~a~~an outer circumferential seal.

4. The pressure regulator of claim 1, further comprising:

a cage with a peripheral wall forming a hollow cylinder,

wherein the pressure-balanced plug is disposed inside of the hollow cylinder and forms a circumferential seal therewith.

5. The pressure regulator of claim 1, wherein the pilot unit comprises:

a manifold with an internal flow network; and

a pair of pilot valves disposed on the manifold and in flow connection with one another via the internal flow network.

6. The pressure regulator of claim 1, wherein the pilot unit comprises:

a fixed differential pressure pilot valve; and

a variable differential pressure pilot valve.

7. The pressure regulator of claim 1, wherein the pilot unit comprises:

a ~~pair of~~second pilot valve ~~configured to vary pressure inside of~~and wherein the ~~pneumatic actuator;~~

orifice is a fixed orifice~~; and~~

~~a check valve~~.

8. The pressure regulator of claim 1, wherein the pneumatic actuator comprises a diaphragm creating a pair of separate, airtight chambers, and wherein the conduit couples the pilot unit to each of the separate, airtight chambers.

9. The pressure regulator of claim 1, further comprising:

a diaphragm disposed in the pneumatic actuator; and

a valve stem coupled on one end to the diaphragm and on the other end to the pressure-balanced plug.

10. An apparatus, comprising:

a valve body with flanged ends;

a trim assembly disposed in the valve body, the trim assembly comprising a cage, a plug disposed in the cage, and a seat disposed at one end of the cage, the plug having openings that extend from a first side to a second side of the plug so as to allow fluid to flow through the plug from space on the first side to space on the second side;

a valve stem coupled with the plug;

an actuator coupled with valve stem, the actuator comprising a diaphragm and a spring; ~~and~~

pilot valves plumbed to the actuator, the pilot valves comprising a first pilot valve and a second pilot valve, one each with a fixed differential pressure and a variable differential pressure~~.~~;

an orifice and check valve coupled with the pilot valves; and

conduit including a first sense line coupling flow between a first side of the check valve on the first pilot valve and a first side of the diaphragm in the actuator, a second sense line coupling flow of fluid between a location downstream of said pressure regulator and the first side of the diaphragm in the actuator, and a load line coupling flow of fluid between a second side of the check valve on the first pilot valve and a second side of the diaphragm in the actuator.

11. The apparatus of claim 10, further comprising:

a manifold with an internal flow network, wherein the pilot valves reside on the manifold and are in flow connection with one another via the internal flow network.

12. The apparatus of claim 10, further comprising:

a manifold comprising a first ported block and a second ported block coupled with one another, the first ported block and the second ported block forming an internal flow network; and

a fixed orifice device disposed in the second ported block,

wherein the pilot valve are disposed on the first ported block and are in flow connection with one another and with the fixed orifice via the internal flow network.

13. The apparatus of claim 10, further comprising:

an actuator housing that is removably coupled to the valve body, the actuator housing comprising a pair of members that mate with each other along a peripheral edge and form an internal chamber, wherein the diaphragm and spring are disposed in the internal chamber.

14. The apparatus of claim 10, wherein the diaphragm creates an upper chamber and a lower chamber in the actuator, and wherein the variable differential pilot valve is plumbed to both the upper chamber and the lower chamber.

15. The apparatus of claim 10, wherein the pilot valves are plumbed to one another in series with the variable differential pilot valve immediately upstream of the actuator.

16. The apparatus of claim 10, wherein the plug has a bifurcated design.

17. A system, comprising:

a flow control comprising a pressure-balanced valve <u>with a plug having openings that extend from a first side to a second side so as to allow fluid to vent from space on the first side to space on the second side</u>;

an actuator having a housing and a diaphragm disposed inside of the housing and coupled with the pressure-balanced valve, the diaphragm creating two separate, airtight chambers in the housing, one on each side of the diaphragm;

a control system, the control system comprising a fixed differential pressure pilot valve and a variable differential pressure pilot valve~~; and~~, and an orifice and a check valve in flow connection with the variable differential pressure pilot valve; and

conduit coupling the variable differential pressure pilot valve to both chambers in the housing, the conduit including a first sense line coupling flow between a first side of the check valve on the variable differential pilot valve and a first side of the diaphragm in the actuator, a second sense line coupling flow of fluid between a location downstream of said pressure regulator and the first side of the diaphragm in the actuator, and a load line coupling flow of fluid between a second side of the check valve on the variable differential pilot valve and a second side of the diaphragm in the actuator.

18. The system of claim 17, wherein the ~~control system comprises~~orifice is a fixed orifice ~~and check valve in flow connection with the variable differential pressure pilot valve~~.

19. The system of claim 17, wherein the housing removeably mounts to the flow control.

20. The system of claim 17, wherein the control system removeably mounts to the housing.