CLAIMS

1. Manifold valve apparatus for selectively directing a fluid flowing in a foreline to a plurality of foreline branches, comprising:

a manifold valve body enclosing a manifold valve chamber, wherein said valve body has an inlet port adapted for fluid-flow connection to the foreline for conducting a flow of fluid into the manifold valve chamber and a plurality of outlet ports adapted for fluid-flow connection to respective foreline branches for conducting flow of fluid out of the manifold valve chamber;

a plurality of closure members, each of which closure members is positioned in the manifold valve chamber between the inlet port and a respective one of the outlet ports and is movable back and forth between (i) an open position in which the closure member allows fluid in the manifold valve chamber to flow through the respective outlet port and out of the valve chamber and (ii) a closed position in which the closure member prevents fluid flow through the outlet port;

actuator apparatus for each of the closure members for moving each of the closure members respectively back and forth between the open position for the respective closure member and the closed position for the respective closure member, the actuator apparatus being of a type comprising a piston for applying a force to move the closure member in one direction, a spring for applying a force to move the closure member in an opposite direction, and a bellows positioned to isolate the manifold valve chamber with an vacuum-tight seal from the piston;

a plurality of expandable and contractible shields positioned in the valve chamber in a manner such that at least the bellows of each actuator apparatus is surrounded by one of the expandable and contractible shields in a manner that separates at least the bellows from gases flowing in the valve chamber and encloses a space around the bellows; and

a plurality of gas ducts that are connectable to a positive pressure gas supply outside of the valve chamber and extend to respective ones of the spaces around the respective bellows that are enclosed by the respective expandable and contractible shields for directing positive pressure gas into the spaces around the bellows that are enclosed by the expandable and contractible shields to maintain the spaces at a pressure higher than a pressure in the valve chamber outside of the shields.

2. The manifold valve apparatus of claim 1, wherein each of said shields comprises a stationary shield section that extends from a portion of the manifold valve body around the bellows toward but not all the way to the closure member, and a movable shield section that extends from the closure member to interface in a movable manner with an outside surface or an inside surface of the stationary shield section and such that the movable shield section is movable reciprocally in relation to the stationary shield section.

3. The manifold valve apparatus of claim 2, wherein there is an annular opening between juxtaposed surfaces of the stationary shield section and the movable shield section and wherein the space enclosed by the shield around the bellows is pressurizable through a respective one of the gas ducts with a sufficient pressure and volume of inert or other gas to create an annular jet flow of inert or other gas from the space inside the shield and through the annular opening to the valve chamber outside of the shield with sufficient force to keep lower pressure gases in the valve chamber away from an outside surface of the shield.

4. The manifold valve apparatus of claim 3, including a guide ring positioned between the stationary and movable shield sections.

5. The manifold valve apparatus of claim 4, wherein the guide ring includes a plurality of bosses that slide on an interfacing surface of one of the shield sections.

6. The manifold valve apparatus of claim 4, wherein the guide ring provides a gap that forms an annular nozzle between an annular surface of the guide ring and the adjacent juxtaposed surface of the shield section.

7. The manifold valve apparatus of claim 1, wherein the bellows is sealed vacuum tight between the manifold valve body and the closure member, and wherein the shield isolates the bellows from the manifold valve chamber to prevent contact between the bellows and fluid flowing through the manifold valve chamber.

8. The manifold valve apparatus of claim 7, wherein: (i) each of the pistons is positioned in a respective cylinder housing mounted on a respective bonnet mounted on the manifold valve body and is connected to a respective piston rod that extends from the respective piston in the respective cylinder housing, through an aperture in the respective bonnet, and to the respective closure member in the manifold valve chamber; (ii) the respective bellows associated with each piston is sealed in a vacuum-tight manner to the respective bonnet and to the respective valve stem or closure member in the valve chamber; and (iii) the respective expandable and contractible shield is positioned in the manifold valve

chamber around the respective bellows in a manner that isolates the bellows from gas flowing in through the manifold valve chamber from the inlet port to any of the outlet ports, said expandable and contractible shield being attached to and extending down from the respective bonnet and to the respective closure member or valve stem such that the respective expandable and contractible shield expands as the respective closure member is moved toward the respective outlet port and contracts as the respective closure member is moved away from the respective outlet port.

9. Valve apparatus, comprising:

a valve body enclosing a valve chamber, wherein said valve body has an inlet port for flow of fluid into the valve chamber and an outlet port for flow of fluid out of the valve chamber;

a closure member positioned in the valve chamber between the inlet port and the outlet port, said closure member being movable back and forth between (i) an open position in which the closure member allows fluid flow from the inlet port and through the outlet port out of the valve chamber and (ii) a closed position in which the closure member prevents fluid flow through the outlet port;

actuator apparatus comprising a pneumatic piston for applying a force to move the closure member to the opened position, a spring for applying a force to move the closure member to the closed position, and a bellows positioned to isolate the piston with a vacuum-tight seal from the valve chamber;

an expandable and contractible shield positioned around at least the bellows in a manner that separates the bellows from gases flowing in the valve chamber and encloses a space around the bellows; and

a gas duct that is connectable to a positive pressure gas supply outside of the valve chamber and extends to the space around the bellows that is enclosed by the expandable and contractible shield for directing positive pressure gas into the space around the bellows that is enclosed by the expandable and contractible shield to maintain the space at a pressure higher than a pressure in the valve chamber outside of the shield.

10. The valve apparatus of claim **9**, wherein said shield comprises a stationary shield section that extends from a portion of the valve body around the actuator apparatus toward but not all the way to the closure member, and a movable shield section that extends from the closure member to interface in a movable manner with the outside or the inside of the stationary shield section and such that the movable shield section is movable reciprocally in relation to the stationary shield section.

11. The valve apparatus of claim **10**, wherein there is an annular opening between juxtaposed surfaces of the stationary shield section and the movable shield section and wherein the space enclosed by the shield around the bellows is pressurizable through the gas duct with a sufficient pressure and volume of inert or other gas to create an annular jet flow of inert or other gas from the space inside the shield and through the annular opening to the valve chamber outside of the shield with sufficient force to keep lower pressure gases in the valve chamber away from an outside surface of the shield.

12. The valve apparatus of claim **11**, including a guide ring positioned between the stationary and movable shield sections.

13. The valve apparatus of claim **12**, wherein the guide ring includes a plurality of bosses that slide on an interfacing surface of one of the shield sections.

14. The valve apparatus of claim **12**, wherein the guide ring provides a gap that forms an annular nozzle between an annular surface of the guide ring and the adjacent juxtaposed surface of the shield section.

15. In a valve that has a valve chamber enclosed by a valve body with an inlet port and an outlet port that accommodates fluid flow through the valve chamber from the inlet port to the outlet port, a closure member in the valve chamber that is movable between an open position and a closed position, an actuator connected to the closure member for moving the closure member between closed and open positions, and a bellows separating the actuator from the fluid flow chamber with a vacuum-tight seal to the closure member and to the valve body, a method of protecting the bellows from particles or corrosive gas flow through the valve chamber, comprising:

preventing the particles or corrosive gas that flow through the valve chamber from entering a space in the valve chamber in which the bellows is positioned by providing an expandable and contractible shield around the space in which the bellows is positioned and maintaining a greater pressure in the space surrounded by the shield than a pressure in the valve chamber outside of the shield by directing a positive pressure flow of inert gas or air from outside of the valve body into the space that is surrounded by the shield.

16. The method of claim **15**, including positioning the expandable and contractible shield in a position in the valve chamber that encloses the space in which the bellows is positioned inside with the expandable and contractible shield and that does not inhibit the fluid flow in the valve chamber outside the expandable and contractible shield from the inlet port to the outlet port.

17. The method of claim 16, including providing the expandable and contractible shield by extending a stationary shield portion from a portion of the valve body around the actuator toward but not all the way to the closure member and extending a movable shield portion from the closure member toward but not all the way to the portion of the valve body around the actuator and in telescopically sliding relation to the stationary shield portion so that movement of the closure member toward and away from the outlet port causes expansion and contraction, respectively, of the expandable and contractible shield by moving the movable shield portion reciprocally in relation to the stationary shield portion.

18. The method of claim 17, including positioning the movable shield portion outside of the stationary shield portion such that an inside surface of the movable shield portion slides along an outside surface of the stationary shield portion.

19. The method of claim 17, including positioning the movable shield portion inside of the stationary shield portion such that an outside surface of the movable shield portion slides along an inside surface of the stationary shield portion.

20. The method of claim 17, including providing an annular gap between the movable shield portion and the stationary shield portion to create an annular jet of the inert gas or air flowing from the annular gap adjacent respective juxtaposed surfaces of the movable shield portion and the stationary shield portion to blow particles or corrosive gas in the fluid flow in the valve chamber away from the surfaces of the movable shield portion and the stationary shield portion.

21. Valve apparatus comprising:

a valve chamber enclosed by a valve body with an inlet port and an outlet port that accommodates fluid flow through the valve chamber from the inlet port to the outlet port;

a closure member in the valve chamber that is movable between an open position and a closed position;

an actuator connected to the closure member for moving the closure member between closed and open positions;

a bellows separating the actuator from the fluid flow chamber with a vacuum-tight hermetic seal to the closure member and to the valve body;

an expandable and contractible shield enclosing a space in the valve chamber in which the bellows is positioned; and

means for providing and maintaining a positive pressure in the space in the valve chamber enclosed by the expandable and contractible shield in which the bellows is positioned that is greater than a pressure in the valve chamber outside of the expandable and contractible shield.