CLAIMS

What is claimed is:

1. A removable filter cartridge, comprising:

a filter housing with an internal volume containing a filter, the filter configured to filter liquid passing through the internal volume, the filter housing including an open end with an inlet and an outlet; and

a sealing valve assembly including:

a first end configured to removably couple the sealing valve assembly to a filter head,

a second end coupled to the open end of the filter housing,

an inlet passageway configured to direct liquid into the inlet of the filter housing,

an outlet passageway configured to direct the liquid discharged from the outlet of the filter housing after being filtered by the filter, and

an inlet sealing valve configured to block the inlet passageway and an outlet sealing valve configured to block the outlet passageway when the sealing valve assembly is uncoupled from the filter head such that the internal volume is sealed while the removable filter cartridge is uncoupled from the filter head.

2. The removable filter cartridge of claim 1, wherein

the inlet sealing valve is one of a gas open valve, a fluid check valve, and a push valve, and

the outlet sealing valve is one of a gas open valve, a fluid check valve, and a push valve.

3. The removable filter cartridge of claim 1, wherein the inlet sealing valve is a gas open valve, the inlet sealing valve including a valve head, a spring biasing the valve head into a closed position that blocks the inlet passageway, and an external gas inlet for supplying compressed gas into the inlet sealing valve.

4. The removable filter cartridge of claim 3, wherein the inlet sealing valve is configured to be actuated from the closed position to an open position by the compressed gas supplied through the external gas inlet.

5. The removable filter cartridge of claim 3, wherein the inlet sealing valve includes an internal space fluidly connected to the external gas inlet, the external gas inlet configured to direct the compressed gas into the internal space to compress the spring and actuate the valve head into an open position.

6. The removable filter cartridge of claim 3, wherein the sealing valve assembly includes a valve body, the valve body including the inlet passageway and the outlet passageway, and the inlet sealing valve and the outlet sealing valve each being coupled to the valve body.

7. The removable filter cartridge of claim 2, wherein the outlet sealing valve is a gas open valve, the outlet sealing valve includes a second external gas inlet, and the outlet sealing valve configured to be actuated from a closed position to an open position by compressed gas supplied to the filter cartridge through the second external gas inlet.

8. The removable filter cartridge of claim 1, wherein the outlet sealing valve is a push valve configured to actuate from a closed position that blocks the outlet passageway to an open position by the removable coupling of the sealing valve assembly to the filter head.

9. The removable filter cartridge of claim 8, wherein the outlet sealing valve is configured to be actuated from the closed position to the open position by a push rod disposed between the sealing valve and the filter head when the sealing valve is removable coupled to the filter head.

10. The removable filter cartridge of claim 9, wherein

the outlet sealing valve includes a valve head and a spring biasing the valve head into the closed position that blocks the outlet passageway, the push rod configured to push the valve head into the open position during the removable coupling of the removable filter cartridge to the filter head.

11. The removable filter cartridge of claim 8, wherein the inlet sealing valve is a fluid check valve configured to be actuated from a closed position that blocks the inlet flow passage to an open position by the filter head supplying the liquid to the inlet passageway.

12. A sealing valve assembly for a removable filter cartridge, the sealing valve comprising:

a first end configured to removably couple the sealing valve assembly to a filter head;

an inlet passageway and an outlet passageway that each extend through the sealing valve assembly;

a second end configured to couple the sealing valve assembly to a filter housing to form the removable filter cartridge such that the inlet passageway directs liquid into an inlet of the filter housing and the outlet passageway directs the liquid discharged from an outlet of the filter housing after passing through the filter housing, the filter housing including an internal volume and a filter configured to filter the liquid passing through the filter housing; and

an inlet sealing valve configured to block the inlet passageway and an outlet sealing valve configured to block the outlet passageway when the sealing valve assembly is uncoupled from the filter head such that the internal volume is sealed while the removable filter cartridge is uncoupled from the filter head.

13. The sealing valve assembly of claim 12, wherein the inlet sealing valve is a gas open valve, the inlet sealing valve including an external gas inlet for supplying compressed gas into the inlet sealing valve to actuate the inlet sealing valve from a closed position that blocks the inlet passageway to an open position.

14. The sealing valve assembly of claim 12, wherein the outlet sealing valve is a gas open valve, the outlet sealing valve including a second external gas inlet for supplying compressed gas into the outlet sealing valve to actuate the outlet sealing valve from a closed position that blocks the outlet passageway to an open position.

15. The sealing valve assembly of claim 12, wherein the outlet sealing valve is a push valve configured to be actuated by a push rod from a closed position that blocks the outlet passageway to an open position by the removable coupling of the sealing valve assembly to the filter head.

16. A method of retrofitting a filter housing, the filter housing having an internal volume containing a filter configured to filter liquid, the method comprising:

removing the filter housing from a filter head, which includes uncoupling the filter housing from the filter head;

coupling a sealing valve assembly to the filter housing to form a removable filter cartridge, which includes coupling a first end of the sealing valve assembly to an open end of the filter housing;

coupling the removable filter cartridge to the filter head, which includes coupling a second end of the sealing valve assembly to the filter head, wherein the sealing valve assembly includes:

an inlet passageway that directs liquid from the filter head into an inlet of the filter housing,

an outlet passageway that directs the liquid discharged from an outlet of the filter housing after passing through the filter to the filter head, and

an inlet sealing valve configured to block the inlet passageway and an outlet sealing valve configured to block the outlet passageway when the sealing valve assembly is uncoupled from the filter head such that the internal volume is sealed while the removable filter cartridge is uncoupled from the filter head.

17. The method of claim 16, further comprising:

supplying compressed gas to an external gas inlet of the inlet sealing valve to actuate the inlet sealing valve from a closed position that blocks the inlet passageway to an open position that allows the liquid to pass through the inlet passageway, the inlet sealing valve being a gas open valve.

18. The method of claim 16, wherein the coupling of the removable filter cartridge to the filter head includes the filter head pushing, via a push rod, a valve head of the outlet sealing valve from a closed position that blocks the outlet passageway into an open position that allows the liquid to pass through the outlet passageway.

19. The method of claim 16, further comprising:

supplying the liquid from the filter head to the inlet passageway of the sealing valve, a pressure of the liquid in the inlet passageway on the inlet sealing valve actuating the inlet sealing valve from a closed position that blocks the inlet passageway to an open position.