CLAIMS

What is claimed is:

1. A removable filter cartridge, comprising:

a filter housing with an internal volume containing a filter configured to filter a liquid; and

a sealing valve including a first end coupled to an open end of the filter housing and a second end configured to removably couple the removable filter cartridge to a filter head, the sealing valve configured to be actuated between an open position and a closed position by one of sliding the sealing valve and rotating the filter housing, wherein

the open position allows liquid flow into and out of the internal volume of the filter housing, and

the closed position seals the internal volume of the filter housing, the sealing valve configured to be actuated from the open position to the closed position while the sealing valve is removably coupled to the filter head and maintain the seal while the removable filter cartridge remains uncoupled.

2. The removable filter cartridge of claim 1, wherein the sealing valve is configured to be actuated by hand between the open position and the closed position.

3. The removable filter cartridge of claim 1, wherein the sealing valve includes a valve body, a valve plate, and an inlet passageway and an outlet passageway extending through the valve body and configured to direct the liquid into and from the filter housing, the valve plate in the closed position blocking the inlet passageway and the outlet passageway.

4. The removable filter cartridge of claim 3, wherein

the valve plate includes a first through hole and a second through hole,

in the open position, the first through hole is aligned with the inlet passageway allowing the liquid to flow through the inlet passageway and the second through hole is aligned with the outlet passageway allowing liquid to flow through the outlet passageway, and

in the closed position, a first portion of the valve plate blocks the inlet passageway and a second portion of the valve plate blocks the outlet passageway.

5. The removable filter cartridge of claim 4, wherein the valve plate includes:

a first side and a second side opposite to the first side, the first through hole extending through the valve body from the first side to the second side,

a first seal on the first side of the valve plate surrounding the first through hole, the first seal configured to provide sealing between the valve plate and the valve body in the open position, and

a second seal on the first side of the valve plate surrounding the first portion of the valve plate, the second seal configured to provide sealing between the valve plate and the valve body in the closed position.

6. The removable filter cartridge of claim 5, wherein the valve plate includes:

a third seal on the second side of the valve plate surrounding the first through hole, the first seal and the second seal configured to provide sealing between the valve plate and the valve body in the open position, and

a fourth seal on the second side of the valve plate surrounding the first portion of the valve plate, the third seal and the fourth seal configured to provide sealing between the valve plate and the valve body in the closed position.

7. The removable filter cartridge of claim 1, wherein the sealing valve is configured to be actuated between the open position and the closed position by sliding the sealing valve, the sealing valve including a valve body coupled to the filter housing and a valve plate slidable in the valve body to actuate the sealing valve between the open position and the closed position.

8. The removable filter cartridge of claim 7, wherein the sealing valve includes a handle affixed to the valve plate, the valve seal configured to be actuated between the open position and the closed position by pushing the handle towards the valve body and pulling the handle away from the valve body.

9. The removable filter cartridge of claim 7, wherein the valve body has a substantially cylindrical shape with an axis, the valve plate has a substantially planar shape, and the valve plate moves between the open position and the closed position by moving along a direction at or about perpendicular to the axis of the substantially cylindrical shape of the valve body.

10. The removable filter cartridge of claim 1, wherein the sealing valve is configured to be actuated between the open position and the closed position by rotating the filter housing, the sealing valve including a valve body and a valve plate disposed in the valve body, the valve plate rotatably coupled to the filter housing such that the valve plate rotates with the filter housing relative to the valve body.

11. The removable filter cartridge of claim 10, wherein the sealing valve includes the valve body and the valve plate disposed in the valve body, the valve plate rotatably coupled to the filter housing, the valve plate configured to be rotatable within the valve body.

12. The removable filter cartridge of claim 10, wherein the valve plate includes a first through hole and a second through hole,

in the open position, the first through hole is aligned with an opening of the inlet passageway allowing the liquid to flow through the inlet passageway and a second through hole is aligned with an opening of the outlet passageway allowing liquid to flow through the outlet passageway,

in the closed position, a first portion of the valve plate blocks the inlet passageway and a second portion of the valve plate extends across and blocks the outlet passageway, the first through hole and the second through hole each being in a rotated position relative to the opening of the inlet passageway and the opening of the outlet passageway, respectively.

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

the first end configured to be removably coupled to a filter head; and

the second end configured to be coupled to a filter housing to form the removable filter cartridge, the filter housing having an internal volume containing a filter, the sealing valve configured to be actuated between an open position and a closed position by one of sliding the sealing valve and rotating the filter housing, wherein

the open position is configured to direct fluid from the filter head into the filter housing and then from the filter housing back to the filter head, and

the closed position is configured to seal the internal volume of the filter housing, the sealing valve configured to be actuated from the open position to the closed position while the sealing valve is removably coupled to the filter head and maintain the seal while the removable filter cartridge remains uncoupled.

14. The sealing valve of claim 13, wherein the sealing valve is configured to be actuated between the open position and the closed position by sliding the sealing valve, the sealing valve including a valve body coupled to the filter housing and a valve body slidable in the valve body to actuate the sealing valve between the open position and the closed position.

15. The sealing valve of claim 13, wherein the sealing valve is configured to be actuated between the open position and the closed position by rotating the filter housing, the sealing valve including a valve body and a valve plate disposed in the valve body, the valve plate rotatably coupled to the filter body such that the valve plate rotates with the filter housing relative to the valve body.

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

removing the filter housing from a filter head, which includes uncoupling an open end of the filter housing from the filter head;

coupling a first end of a sealing valve to the open end of the filter housing to form a removable filter cartridge;

removably coupling the removable filter cartridge to the filter head, which includes removably coupling a second end of the sealing valve to the filter head, the sealing valve is configured to be actuated between an open position and a closed position, wherein

the open position is configured to direct fluid from the filter head into the filter housing and then from the filter housing back to the filter head, and

the closed position is configured to seal the internal volume of the filter housing, the sealing valve configured to be actuated from the open position to the closed

position while the sealing valve is removably coupled to the filter head and maintain the seal while the removable filter cartridge remains uncoupled.

17. The method of claim 16, wherein the seal member includes a valve plate slidable in a valve body, the method further comprising:

actuating the sealing valve between the open position and the closed position, which includes sliding the valve plate into the valve body.

18. The method of claim 16, wherein the seal member includes a valve gate disposed in a valve body, the valve gate rotatable coupled to the filter housing, the method further comprising:

actuating the sealing valve between the open position and the closed position, which includes partially uncoupling the filter housing from the sealing valve and rotating the filter housing to rotate the valve gate relative to the valve body.