Claims

1. Filter device for removing particles from a liquid, wherein the filter device comprises a fluid chamber and an inlet for liquid, an outlet for filtered liquid and an outlet for particles, each coupled to the fluid chamber, wherein the filter device further comprises a flow directing mechanism for inducing a vortex flow around a vortex axis in said fluid chamber, **characterized in that** the outlet for particles is coupled to the fluid chamber at a location substantially perpendicular to the vortex axis, wherein the filter device further comprises an inlet chamber coupled to the inlet, wherein the inlet chamber is delimited from the fluid chamber by a wall member, wherein the wall member comprises at least one opening being shaped to induce the vortex flow in the fluid chamber.

2. Filter device according to claim 1, wherein the fluid chamber is substantially cylindrical and wherein the outlet for particles is arranged at the cylindrical wall.

3. Filter device according to claim 1 or 2, wherein the fluid chamber has a varying diameter, wherein the outlet for particles is arranged at a location of the fluid chamber with largest diameter.

4. Filter device according to claim 1, 2 or 3, wherein at least a part of the inner wall of the fluid chamber is provided with a groove, wherein the outlet for particles is arranged in the groove.

5. Filter device according to any of the preceding claims, wherein the outlet for particles is provided with a valve which movable between an open and a closed position.

6. Filter device according to claim 5, wherein the valve is a solenoid valve.

7. Filter device according to claim 5 or 6, further comprising a timing device for closing and opening the valve.

8. Filter device according to claim 5, 6 or 7, further comprising a battery system for powering the valve.

9. Filter device according to any of claims 5 to 8, further comprising a photovoltaic system for powering the valve.

10. Filter device according to any of claims 5 to 8, further comprising a turbine generator, wherein said turbine generator is arranged for generating electric power from the liquid flow.

11. Filter device according to claim 10, wherein the turbine generator is located downstream from the outlet for filtered liquid.

12. Filter device according to any of the preceding claims, wherein the outlet for liquid is aligned with the vortex axis.

13. Filter device according to any of the preceding claims, further comprising a sieve, wherein the sieve is arranged upstream from the outlet for filtered liquid.

14. Filter device according to claim 13, wherein the sieve has a cylindrical shape.

15. Filter device according to claim 14, wherein the cylindrical sieve is coaxially arranged around the outlet for filtered liquid between the wall member and the wall of the fluid chamber.

16. Filter device according to claim 13, 14 or 15, wherein the sieve is a filter.

17. Filter device according to any of claims 13 to 16, where the sieve comprises wire mesh, wherein the wire mesh is woven using thread with a round cross section.

18. Filter device according to any of the preceding claims, wherein the housing of the filter device comprises two housing parts.

19. Filter device according to claim 18, wherein the wall member is secured between the two housing parts.

20. Filter device according to claim 15 and 19, wherein the sieve is secured between a housing part and the wall member.

21. Filter device according to any of the preceding claims, wherein the inlet chamber comprises an inlet chamber sieve for sifting the liquid upstream from the wall member.

22. Filter device according to claim 21, wherein the inlet chamber sieve is supported by the wall member.

23. Filter device according to claim 21 or 22, wherein the inlet chamber sieve is a mesh.

24. Filter device according to claim 21 or 22, wherein the inlet chamber sieve is a perforated plate.

25. Filter device according to any of claims 21 to 24, wherein the inlet chamber sieve is provided with a plurality of truncated cones, wherein an opening from an upstream top to a downstream base of a truncated cone is oriented to the direction of liquid flow, wherein the cross sections of the truncated cones diverge in the direction of the liquid flow.

26. Filter device according to claim 25, wherein the normal of the plane of the upstream top of a truncated cone is at an angle relative to the direction of liquid flow.

27. Filter device according to any of claims 21 to 26, wherein the inlet chamber sieve is made by punching or by injection molding.

28. Filter device according to any of claims 21 to 27, wherein the inlet chamber comprises an outlet for particles blocked by the inlet chamber sieve.

29. Filter device according to claim 28, further comprising a blocked particle outlet valve arranged to block any axial flow through the outlet for blocked particles in a closed position.

30. Filter device according to any of claims 28 to 29, wherein the inlet chamber further comprises a second inlet for flushing the blocked particles from the inlet chamber to an outlet for blocked particles.

31. Filter device according to claim 30, further comprising a second inlet valve arranged to block any axial flow through the second inlet in a closed position.

32. Filter device according to any of claims 30 to 31, wherein a pump is arranged upstream from the second inlet for introducing a fluid into the inlet chamber for the flushing.

33. Filter device according to any of the preceding claims, wherein the wall member comprises a plurality of tangentially oriented nozzles for inducing the vortex flow in the fluid chamber.

34. Filter device according to any of the preceding claims, wherein the outlet for filtered liquid is aligned with the inlet for liquid.

35. Fluid piping system provided with a filter device according to any of the preceding claims.

36. Method for filtering a liquid using a filter device according to any of the preceding claims, wherein the method comprises introducing a liquid in the liquid inlet, filtering said liquid and providing filtered liquid from the outlet for liquid.

37. Method according to claim 36, further comprising the step of flushing the filter device including:
- limiting the flow at the outlet for liquid;
- opening the valve provided in the outlet for particles from a closed position to an open position during a predetermined period of time;
- collecting the particles from the outlet for particles, and;
- moving the valve to the closed position.

38. Method according to claim 36 or 37, further comprising the step of flushing the inlet chamber including:
- introducing a fluid into the inlet chamber through the second inlet, and;
- collecting the blocked particles from the inlet chamber through the outlet for blocked particles.

39. Method according to any of claims 36 to 38, further comprising the step of flushing the fluid chamber including:
- introducing a fluid into the inlet chamber through the second inlet, and;
- collecting the particles from the fluid chamber through the outlet for particles.

40. Method according to any of claims 36 to 39, further comprising the step of timing the closing and opening of the valve including:
- providing a timing device for providing a time setting for closing and opening the valve for a predetermined period of time, and;
- providing a signal for closing or opening the valve based on the time setting.