portion adjacent the sidewall having a relatively large diameter D2, a number of partitions extending in the proximal portion from a position at or near the sidewall towards the distal channel portion at an angle (β) to a centre line of the cleaning duct.

By use of the partitions, sub-channels are formed in the cleaning fluid duct that result in a gradual decrease in outflow velocity that reduce turbulence in the outflow channel, even when the outflow diameter D2 is relatively large and the length of the proximal cleaning channel portion is relatively short. The angle (β) of the partitions with the center line of the cleaning fluid duct is less than 20^0, preferably less than 10^0, more preferably less than 8^0.

In one embodiment, the proximal channel portion comprises a peripheral wall that is at an angle (α) with respect to the centre line of between 10^0 and 70^0, preferably between 30^0 and 60^0, more preferably about 45^0. The short proximal channel portion is strongly diverging to cover a large surface area of the filter housing, so that the filter elements in the housing are effectively flushed over their entire height while the total volume of the moving cleaning fluid is reduced and thus the effects of water hammer are minimised.

In another embodiment, a cross-section of the cleaning duct near the sidewall is rectangular, the duct having sidewalls and transverse walls, wherein the partitions bridge the distance between the sidewalls and/or between the transverse walls. In such a rectangular cleaning duct, the partitions may be flat, plate-shaped elements arranged in a grid-shaped configuration to form a diffusor. Alternatively the cross-section of the cleaning duct may be of circular shape, the partitions being formed of coaxial conical members.

A further embodiment of a filter device according to the invention is characterised in that inside the housing a cylindrical distributor element is provided, comprising a perforated wall at a distance from the cylindrical wall, an annular flow channel being defined between the distributor element and the wall.

By the distributor element, the inflowing cleaning fluid entering the housing through the cleaning duct is distributed circumferentially around the filter elements, before entering into the filter elements. Hereby the differences in velocity in the fluid entering into the flow channel is reduced, which limits the pressure differences and a circumferential even distribution of the

cleaning fluid across the array of filter elements is warranted. Furthermore, the distributor element prevents forces on the filters elements nearest to the inlet of the fluid in the housing wall from exceeding a predetermined maximum value.

The distributor element may be formed by a perforated cylindrical wall, extending inside the housing at a distance from the inner housing wall, the perforations extending substantially along the height of the distributor wall.

In a preferred embodiment, a distance of the distributor element from the cylindrical wall decreases when going from a position on the cylindrical wall near the cleaning duct to a position diametrically opposite the cleaning duct. In this way the velocity differences around the perimeter of the distributor wall after entering into the circumferential flow channel around the filter elements are reduced and thus the pressure differences, because of the flow channel's decreasing diameter in the flow direction, i.e. in the direction away from the inflow position of the cleaning fluid. This helps further diminish the head loss and improve the cleaning fluid distribution. The annular distributor element may be placed in an eccentric position relative to the outer wall, in closer proximity to the outer wall for circumferential positions that are located further away from the cleaning duct.

In view of the above, according to an aspect of the present invention, there is provided a filter device for a water treatment facility, the filter device comprising a housing with an end part and a cylindrical side wall and containing an axially arranged array of filter elements, an inlet for supplying raw water to the filter elements and an outlet for transporting filtered water from the housing, the side wall of the filter device being provided with a cleaning duct for supplying cleaning fluid to the filter elements via the side wall, the cleaning duct comprising a distal channel portion having a relatively small diameter D1 and a proximal portion adjacent and diverging to the side wall, the proximal portion having a relatively large diameter D2 that is greater than the relatively small diameter D1, a number of partitions extending in the proximal portion from a position at or near the sidewall towards the distal channel portion at an angle (β) to a centre line of the cleaning duct, wherein said partitions, in the direction from the side wall towards the distal channel portion, extend in a direction towards the centre line.

Brief description of the drawings

Some embodiments of a filter device in accordance with the present invention will, by way of non-limiting example, be described in detail with reference to the accompanying drawings. In the drawings:

Fig. 1 shows a schematic lay-out of the filter device and cleaning fluid reservoir in the water treatment mode,

Fig. 2 shows the filter device of fig. 1 in a reverse flow cleaning mode,

Fig. 3 shows a three-dimensional view of the filter device of the present invention comprising an array of ceramic filter elements,

is removed and flushed out through the cleaning outlet duct 14. A cleaning reservoir arrangement suitable for use with the filter device of the present invention is described in NL 2 010 002 that was filed in the name of the applicant.

In order for the cleaning fluid to have a gradual decrease in velocity upon entry into the housing 2 and to reduce energy losses and prevent water hammer by sudden pressure increase, the duct 6 is provided with a relatively narrow distal duct section 15 and a diverging duct section 16, as shown in fig. 3.

The distal duct section 15 has a diameter D1 of for instance 80 cm and has a length Ld of about 0.5 m - 2 m and the diverging duct section 16 has a length Lp of about 0.3 m-2 m and a diameter D2 at the position of the sidewall 2 of 140 cm. The angle α of the outer diverging walls of the proximal duct section 16 relative to the centre line 20 of the cleaning duct 6, is for instance about 11 degrees. The compact footprint of the filter device according to the invention allows the use of several cleaning fluid reservoirs and filter housings 2, multiple filter housings 2 being connected to one reservoir 13, with a capacity of for instance several thousand L/hour in a single small sized water treatment facility.

Inside the diverging proximal channel section 16 is a number of plate-shaped partitions 21,22, 23, 24 that extend along the entire width (perpendicular to the plane of the drawing) of the proximal channel section 16. The partitions 21-24 are at an angle β of between 5^0 and 20^0 relative to the centre line 20.

Fig. 5 shows a cross-sectional view of the proximal channel section 16 near the position of the sidewall of the housing 2. The channel section is bounded by top and bottom walls 25, 26 and side walls 27, 28. The partitions 21-24 are symmetrically arranged with respect to the channel centre line 20. In the embodiment of fig. 6, the partitions 21-24 that are parallel to the top and bottom walls 25, 26, together with transverse partitions 30, 31, 32 that are parallel to the side walls 27, 28, form a grid-like diffuser construction.

In fig. 6 an embodiment is shown in which the cross-sectional shape of the outer wall 35 of the channel section 16 is circular, and the partitions 36, 37 are formed of conical segments centred around the centre line 20.

In the embodiment shown in fig. 8, it can be seen that a perforated annular inner wall 60 is placed inside the housing 2. Water is entering in between adjacent cylindrical filter elements 3, through the holes 61 of the inner wall 60 in the direction of arrows F. The cylindrical outer wall 50 of the housing 2 is offset from the centre of the perforated inner wall 60, the outer wall 50 and the perforated inner wall 60 being situated closer together at circumferential positions that are further away from the channel section 16. In this way, the diameter of the circumferential flow channel 52 is larger at position A closer to the channel 16 than at position B. At position A for instance a distance between the outer wall 50 and the inner wall 60 is about 25 cm whereas at position B this distance amounts to 5 cm. Water entering into the housing via channel section 16 is diffused through the openings 61 in the inner wall 60 and partly flows through the channel 52 around the outside of inner wall 60 in a circumferential direction while maintaining sufficient pressure to radially enter into the filter elements that are disposed within the perforated wall 60 while preventing excess pressure on the filter elements near position A. In this way, the head loss of the fluid entering into the flow channel reduced and an even azimuthal distribution of cleaning fluids entering into the filter elements in a radial direction, is obtained.

As can be seen in fig. 9, the holes 61 at the upper and lower sides of the inner wall 60 are of larger diameter in view of the reduced diameter of the cylindrical filter elements, which at the axial position of the upper and lower sides of the wall 60 are provided with a connector of a reduced diameter.

Furthermore, the holes 61 are aligned in the axial direction to form vertical rows that are situated in such a perimetrical position that they allow cleaning fluid to pass between adjacent cylindrical filter elements that are placed in proximity to the holes.

Claims

1. Filter device for a water treatment facility, said filter device comprising a housing with an end part and a cylindrical side wall and containing an axially arranged array of filter elements, an inlet for supplying raw water to the filter elements and an outlet for transporting filtered water from the housing, the side wall of the filter device being provided with a cleaning duct for supplying cleaning fluid to the filter elements via the side wall, the cleaning duct comprising a distal channel portion having a relatively small diameter D1 and a proximal portion adjacent and diverging to the side wall, the proximal portion having a relatively large diameter D2 that is greater than the relatively small diameter D1, a number of partitions extending in the proximal portion from a position at or near the sidewall towards the distal channel portion at an angle (β) to a centre line of the cleaning duct, wherein said partitions, in the direction from the side wall towards the distal channel portion, extend in a direction towards the centre line.

2. Filter device according to claim 1, wherein the proximal portion comprises a peripheral wall that is at an angle (α) with respect to the centre line of between 10^0 and 70^0, preferably between 30^0 and 60^0, more preferably about 45^0, wherein said peripheral wall, in the direction from the side wall towards the distal channel portion, extends in a direction towards the centre line.

3. Filter device according to claim 1 or 2 wherein the angle (β) is less than 20^0, preferably less than 10^0, more preferably less than 8^0.

4. Filter device according to any one of claims 1-3, wherein a cross-section of the cleaning duct near the sidewall is rectangular, the duct having sidewalls and transverse walls, wherein the partitions bridge the distance between the sidewalls and/or between the transverse walls.

5. Filter device according to claims 1,2 or 3, the partitions being flat, plate-shaped elements arranged in a grid-shaped configuration.

6. Filter device according to claim 3, the cross-section of the cleaning duct being of circular shape, the partitions being formed of coaxial conical members.

7. Filter device according to any one of the preceding claims, characterised in that inside the housing a cylindrical distributor element is provided, comprising a perforated wall at a distance from the cylindrical wall, an annular flow channel being defined between the distributor element and the wall.

8. Filter device according to claim 7, a distance of the distributor element from the cylindrical wall decreasing when going from a position on the annular wall near the cleaning duct to a position diametrically opposite the cleaning duct.

9. Filter device according to claim 7 or 8, the distributor element comprising a perforated annular inner wall having openings distributed along its circumferential surface.

10. Filter device according to any one of the preceding claims, wherein the outlet and the cleaning duct are combined.

11. Filter device according to any one of the preceding claims, wherein the cleaning duct is connected to the outlet via an outlet valve for allowing the filtered water to pass through the sidewall via the cleaning duct to the outlet.

12. Filter device according to any one of the preceding claims, wherein the array of filter elements is arranged for letting the raw water enter into the array of filter elements in the axial direction and leaving the array through a side surface of the filter elements.

13. Filter device according to any one of the preceding claims, wherein the cleaning fluid is water.

14. Filter device according to any one of the preceding claims, wherein the array of filter element is an array of ceramic or polymer filter elements.