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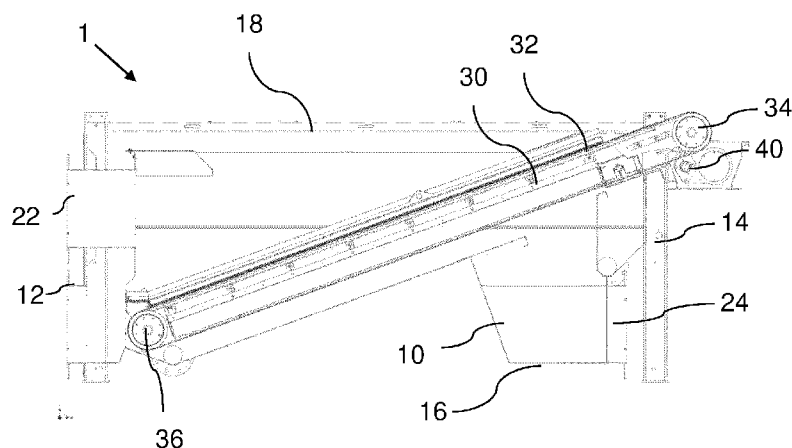


Fig. 1

(57) Abstract: A belt filter (1) for removing particles from a fluid comprises a vessel (10), a continuous screen belt (32) forming a loop having an upper surface and a lower surface, and a support structure (34, 36) being adapted to drive the continuous screen belt (32). A belt cleaning device (40) is provided below the lower surface of the belt (32) and comprises a transverse shaft (42) having a mantle surface, and a plurality of cleaning elements (44) attached to the shaft (42). Each of the cleaning elements (44) comprises an elongated member having a longitudinal extension along the shaft (42), and a radial extension away from the mantle surface of the shaft (42), wherein the radial extension is equal to or less than a distance between the mantle surface of the shaft and the lower surface of the screen belt (32), an efficient and careful cleaning of the belt is provided.



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BELT FILTER

Technical field

[0001] The present invention relates generally to belt filters and more particularly to a belt filter with an improved belt cleaning capability.

Background art

[0002] So-called belt filters are known for removing or separating particles from a fluid, such as water, in a cost-effective and space-efficient way, for example in municipal waste water and sedimentation processes. Other application areas are fish farming and fish processing. By means of a belt filter, a dry sludge is provided without the need for added chemicals.

[0003] A prior art belt filter works according to the following general principles. Untreated water or other fluid to be treated is led into the filter and particles are separated when the water passes through a screen belt. This screen belt rotates when it needs cleaning. The belt is cleaned principally by brush and then flushed at a high pressure. Alternatively, the belt can be cleaned by air. The particles separated by the brush are transported internally in the filter to a press that de-waters the sludge to a very high dry content. The waste water is drained out of the filter separately and can normally be led back to the incoming water.

[0004] A drawback with using a brush for cleaning the belt is the wear caused by the contact between the bristles and the belt. Also, the brush gets clogged and needs frequent cleaning for proper function.

Summary of invention

[0005] An object of the present invention is therefore to provide a belt filter with an improved cleaning function.

[0006] According to the invention, a belt filter for removing particles from a fluid is provided, the belt filter comprising a vessel with a fluid inlet pipe at a first end of the vessel and an outlet for particles removed from the fluid at a second end of the vessel opposite to the first end, a continuous screen belt (32) forming a loop

having an upper surface and a lower surface, a support structure being adapted to, during operation, drive the continuous screen belt such that the upper surface is moved in a direction from the first end of the vessel to the second end of the vessel, a belt cleaning device provided below the lower surface of the continuous screen belt, the belt cleaning device comprising a shaft having a mantle surface, the shaft extending across the lower surface of the continuous screen belt, and a plurality of cleaning elements attached to the mantle surface of the shaft, the belt filter being characterized in that each of the cleaning elements comprises an elongated member having an longitudinal extension along the shaft, and a radial extension away from the mantel surface of the shaft, wherein the radial extension, during rotation of the shaft, is equal to or less than a distance between the mantle surface of the shaft and the lower surface of the screen belt.

[0007] In a preferred embodiment, the radial extension of the cleaning elements is such that the distance between the cleaning elements and the lower surface of the screen belt is 0-15 millimetres, even more preferably 1-15 millimetres, most preferably 1-10 millimetres.

[0008] In a preferred embodiment, the belt cleaning device is provided essentially below the drive roller.

[0009] In a preferred embodiment, the belt cleaning device, during operation, is adapted to rotate in a direction opposite to the direction of motion of the lower surface of the screen belt.

[0010] In a preferred embodiment, the cleaning elements have the form of mutually parallel vanes.

[0011] In a preferred embodiment, the cleaning elements are arranged in parallel with the shaft of the belt cleaning device. Alternatively, the cleaning elements extend helically along the shaft of the belt cleaning device.

[0012] In a preferred embodiment, the plurality of cleaning elements of the belt cleaning device is uniformly distributed around the shaft of the belt cleaning device.

[0013] In a preferred embodiment, the number of cleaning elements of the belt cleaning device is any of the following: four, six, and eight.

[0014] In a preferred embodiment, the cleaning elements are made of a resilient material, preferably rubber or resilient plastics.

[0015] In a preferred embodiment, two adjacent cleaning elements are part of the same cleaning element unit, the cleaning element unit comprising a mounting portion interconnecting two cleaning elements. In this preferred embodiment, the belt cleaning device preferably comprises a plurality of attachment pieces, each attachment piece being placed above a respective mounting portion of cleaning element unit so that the mounting portion is provided between the shaft and the attachment piece.

[0016] In a preferred embodiment, radially outer edges of the cleaning elements, during operation, are adapted to move above the lower surface of the screen belt at a speed of between 1.0 and 3.0 meters per second, even more preferably at a speed of between 1.8 and 2.2 meters per second, relatively to the lower surface of the screen belt (32).

[0017] In a preferred embodiment, the screen belt is constructed of polyester.

[0018] In a preferred embodiment, the screen belt has a mesh opening size of 100-1000 μm .

[0019] In a preferred embodiment, screen belt, during operation, is adapted to move at a linear velocity of 400 centimetres per minute, more preferably at a linear velocity of from 200 centimetres per minute to about 1500 centimetres per minute.

Brief description of drawings

[0020] The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is an overall view of a belt filter according to the invention.

Fig. 1a is an enlarged part of Fig. 1 showing a belt cleaning device comprised in the belt filter.

Fig. 2 shows a perspective view the belt cleaning device of Fig. 2.

Fig. 3 is a cross-sectional view of the belt cleaning device of Fig. 2.

Fig. 4 is a close-up view of part of a belt cleaning device comprised in the belt filter of Fig. 1.

Fig. 5 is a perspective view of a vane unit forming part of the belt cleaning device of Fig. 2.

Fig. 6 is a side view of a vane unit forming part of the belt cleaning device of Fig. 2.

Description of embodiments

[0021] In the following, a detailed description of a belt filter will be given. In this description, any references such as “above” or “below” refers to what is shown in the figures.

[0022] An overall view of a belt filter according to the invention, generally designated 1, is shown in Fig. 1. The belt filter 1 is constructed as a vessel 10 with a first end wall 12 and a second end wall 14 and having a bottom plate 16 and a top plate 18. Side walls (not shown in the figure) complete the vessel 10.

[0023] A fluid inlet pipe 22 is preferably disposed in the first end wall 12 of the belt filter 1 for passing an inlet fluid stream comprising water to be cleaned. At the second end wall 14 of the belt filter 1 an outlet 24 is provided for passing separated particles from the belt filter 1 to disposal.

[0024] The belt filter 1 comprises a filter arrangement 30 with a continuous screen belt 32 forming a loop having an upper surface facing upward and a lower surface facing downward. The screen belt 30 is preferably constructed of polyester which exhibits excellent self-lubricating properties, but materials such as nylon, polyethylene, polypropylene, or other materials as are known in the art, may be

used with satisfactory results. Screen belt 30 preferably has a mesh opening size of 100-1000 μm . The ends of the screen belt 32 are preferably connected to form a continuous loop by flexible lacing, as is known in the art.

[0025] The screen belt 32 is supported by a support rail. The screen belt 32 is also supported and held in tension by a mechanized tensioning device comprising a drive roller 34, which drives and tensions the screen belt 32, and an idler roller 36. The drive roller 34 is in turn driven by a drive assembly (not shown in the figures), which preferably comprises an electric motor, a variable speed mechanical drive, and a gear, although one skilled in the art will recognize that other drive means may be used without departing from the scope of the invention. The drive assembly drives the drive roller 34 directly via a drive shaft. The drive roller 34 preferably moves the screen belt 32, during operation, at a linear velocity of approximately 400 centimetres per minute. Depending on the flow rate of the inlet fluid stream, the speed of the screen belt 32 may vary from 200 centimetres per minute and about 1500 centimetres per minute.

[0026] A belt cleaning device 40 for cleaning the screen belt 32 is provided at the underside of the screen belt 32 close to the end thereof facing the second end wall 14. In other words, the belt cleaning device 40 is provided essentially below the drive roller 34. The function of the belt cleaning device 40 is to remove particles attached to the surface of the screen belt 32. The belt cleaning device 40 is driven by a cleaning device drive assembly 60, see Fig. 2. The cleaning device drive assembly preferably comprises an electric motor driving the belt cleaning device 40 via a belt transmission to achieve the correct rotational speed. The belt cleaning device 40 rotates in a direction opposite to the direction of motion of the lower surface of the screen belt 32.

[0027] The belt cleaning device 40 will now be described in detail with reference to Figs. 3 and 4. The cleaning device comprises a shaft 42 adapted to rotate at a speed determined by the cleaning device drive assembly 60. to which the shaft 42 is connected. A plurality of cleaning elements in the form of elongated members 44 are provided on and extend from the mantle surface 42a of the shaft 42. Each vane 44 thus has a radial extension, designated R in Fig. 3, away from the mantle

surface 42a of the shaft 42. These elongated members 44 have the form of mutually parallel vanes. In the embodiment shown in Fig. 3, there are four vanes 44 uniformly distributed around the shaft 42. However, the number of vanes 44 may be more than four, such as six or eight.

[0028] The vanes 44 are preferably made of a resilient material, such as rubber or resilient plastics. In a preferred embodiment, see also Figs. 5 and 6, two adjacent vanes 44 are part of the same vane unit. This vane unit comprises a mounting portion 46 interconnecting the two vanes 44. A perspective and a side view, respectively, of the vane unit 44, 46 are shown in Figs. 5 and 6 before mounting to the shaft 42. During mounting, the mounting portion 46 is placed against the shaft 42 and attachment pieces 48 are placed above the mounting portion 46. The attachment pieces 48 have a curvature corresponding to that of the mantle surface of the shaft 42. The attachment pieces 48 are then removably attached to the shaft 42 by means of screws 48a. In the embodiment shown in Fig. 3, two vane units 44, 46 are provided on opposite sides of the shaft and four attachment pieces are provided to keep them in place.

[0029] Turning back to Figs. 1 and 1a, as already mentioned, the belt cleaning device 40 is located below the turning point of the screen belt 32 and is arranged to counter-rotate to the rotation direction of the lower surface of the screen belt 32. The belt cleaning device 40 is mounted at a distance from the underside of the screen belt 32 so that the edges of the vanes 44, i.e., the radially outward portion of the vanes, during rotation of the shaft 32, barely touch the belt or even more preferably pass at a small distance from the surface of the screen belt 32, see Fig. 1a. In a preferred embodiment, there is a distance of 0-15 millimetres, even more preferably 1-15 millimetres, most preferably 1-10 millimetres, thereby creating an air suction effect or "vacuum", which removes the particles from the belt without unnecessary wear on the screen belt 32.

[0030] The fins or vanes may be arranged in parallel with the rotation axis, as shown in Figs. 1-5, or they may extend helically along the shaft 42.

[0031] In order to remove the particles from the surface of the screen belt 32, it is preferred that the shaft 32 rotates at a speed to that the periphery of the belt cleaning device 40, i.e., the edges of the vanes 44, move above the lower surface of the screen belt 32 at a speed of between 1.0 and 3.0 meters per second, even more preferably at a speed of between 1.8 and 2.2 meters per second.

[0032] The vanes have been shown to extend all along the shaft of the belt cleaning device. It will be appreciated that shorter vanes can be provided, extending only partially along the shaft of the belt cleaning device, without departing from the inventive idea.

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CLAIMS

1. A belt filter (1) for removing particles from a fluid, comprising:
- a vessel (10) with a fluid inlet pipe (22) at a first end of the vessel and an outlet (24) for particles removed from the fluid at a second end of the vessel opposite to the first end,
 - a continuous screen belt (32) forming a loop having an upper surface and a lower surface,
 - a support structure (34, 36) being adapted to, during operation, drive the continuous screen belt (32) such that the upper surface is moved in a direction from the first end of the vessel to the second end of the vessel (10),
 - a belt cleaning device (40) provided below the lower surface of the continuous screen belt (32), the belt cleaning device (40) comprising a shaft (42) having a mantle surface, the shaft extending across the lower surface of the continuous screen belt (32), and a plurality of cleaning elements (44) attached to the mantle surface of the shaft (42),

characterized in that

- each of the cleaning elements (44) comprises an elongated member having a longitudinal extension along the shaft (42), and a radial extension (R) away from the mantle surface (42a) of the shaft (42),
- wherein the radial extension, during rotation of the shaft (42), is equal to or less than a distance between the mantle surface of the shaft and the lower surface of the screen belt (32).

2. The belt filter according to claim 1, wherein the radial extension of the cleaning elements (44) is such that the distance between the cleaning elements (44) and the lower surface of the screen belt (32) is 0-15 millimetres, even more preferably 1-15 millimetres, most preferably 1-10 millimetres.

3. The belt filter according to claim 1 or 2, wherein the belt cleaning device (40) is provided essentially below the drive roller (34).
4. The belt filter according to any one of claims 1-3, wherein the belt cleaning device (40), during operation, is adapted to rotate in a direction opposite to the direction of motion of the lower surface of the screen belt (32).
5. The belt filter according to any one of claims 1-4, wherein the cleaning elements (44) have the form of mutually parallel vanes.
6. The belt filter according to any one of claims 1-5, wherein the cleaning elements (44) are arranged in parallel with the shaft (42) of the belt cleaning device (40).
7. The belt filter according to any one of claims 1-5, wherein the cleaning elements (44) extend helically along the shaft (42) of the belt cleaning device (40).
8. The belt filter according to any one of claims 1-7, wherein the plurality of cleaning elements (44) the belt cleaning device (40) are uniformly distributed around the shaft (42) of the belt cleaning device (40).
9. The belt filter according to any one of claims 1-8, wherein the number of cleaning elements (44) of the belt cleaning device (40) is any of the following: four, six, and eight.
10. The belt filter according to any one of claims 1-9, wherein the cleaning elements (44) are made of a resilient material, preferably rubber or resilient plastics.
11. The belt filter according to any one of claims 1-10, wherein two adjacent cleaning elements (44) are part of the same cleaning element unit, the cleaning element unit comprising a mounting portion (46) interconnecting two cleaning elements (44).
12. The belt filter according to claim 11, wherein the belt cleaning device (40) comprises a plurality of attachment pieces (48), each attachment piece (48) being

placed above a respective mounting portion (46) of cleaning element unit so that the mounting portion (46) is provided between the shaft (42) and the attachment piece (48).

13. The belt filter according to any one of claims 1-12, wherein radially outer edges of the cleaning elements (44), during operation, are adapted to move above the lower surface of the screen belt (32) at a speed of between 1.0 and 3.0 meters per second, even more preferably at a speed of between 1.8 and 2.2 meters per second, relatively to the lower surface of the screen belt (32).

14. The belt filter according to any one of claims 1-13, wherein the screen belt (32) is constructed of polyester.

15. The belt filter according to any one of claims 1-14, wherein the screen belt (32) has a mesh opening size of 100-1000 μm .

16. The belt filter according to any one of claims 1-15, wherein screen belt (32), during operation, is adapted to move at a linear velocity of 400 centimetres per minute, more preferably at a linear velocity of from 200 centimetres per minute to about 1500 centimetres per minute.

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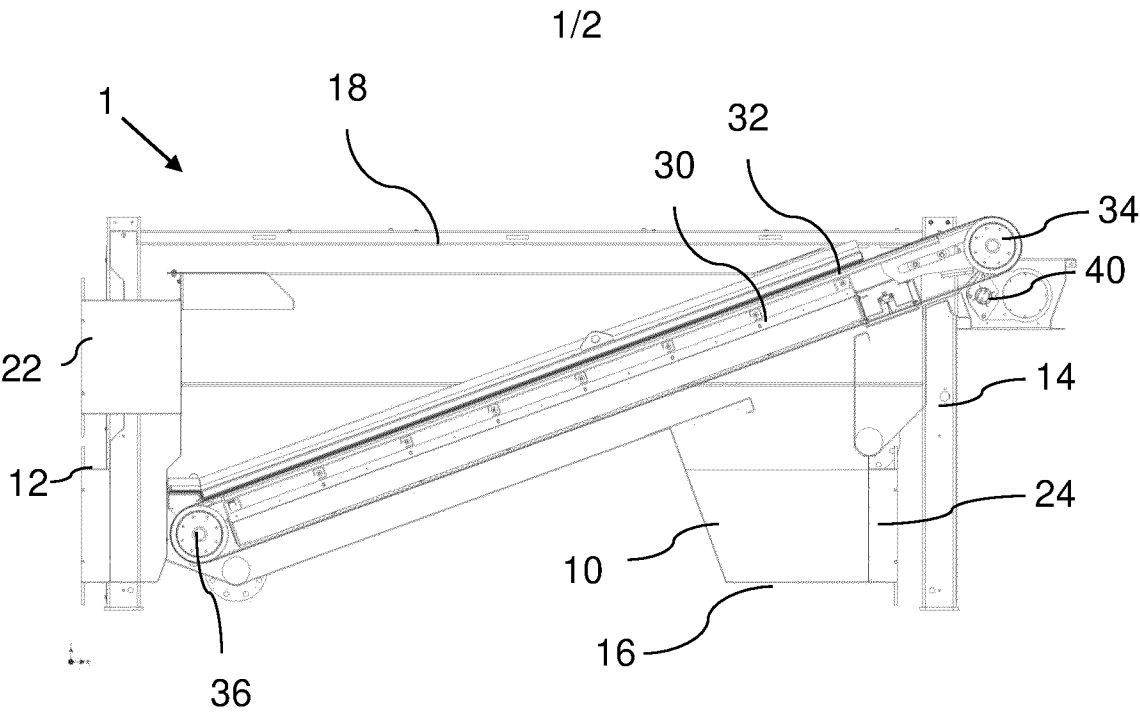


Fig. 1

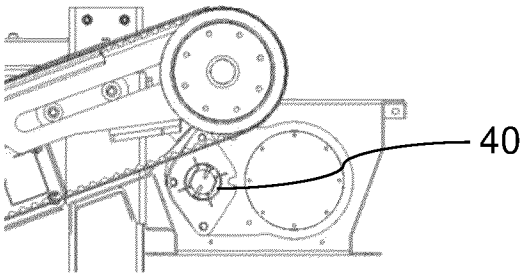


Fig. 1a

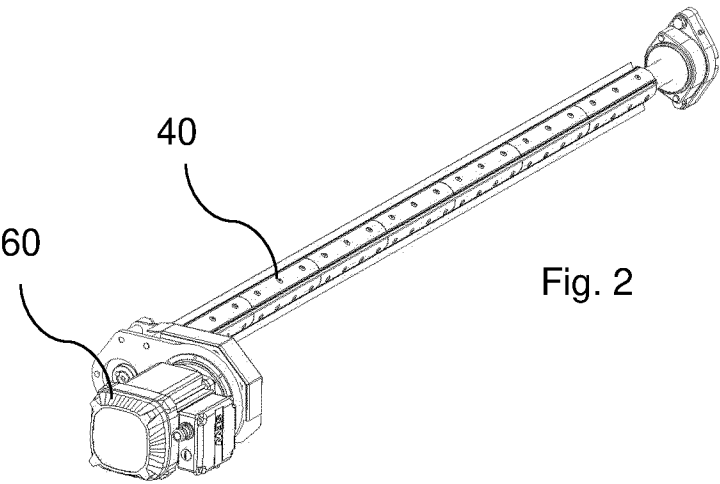
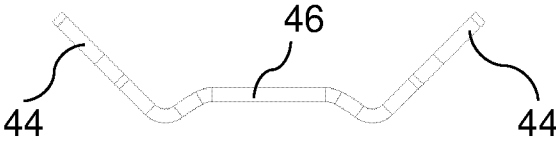
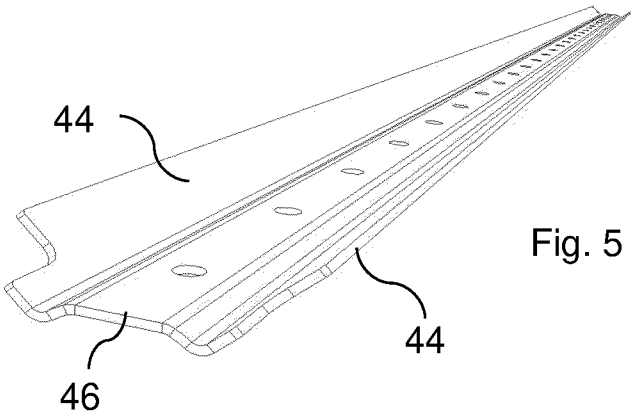
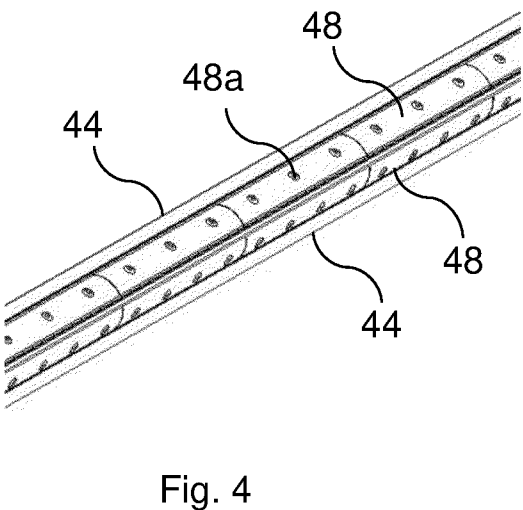
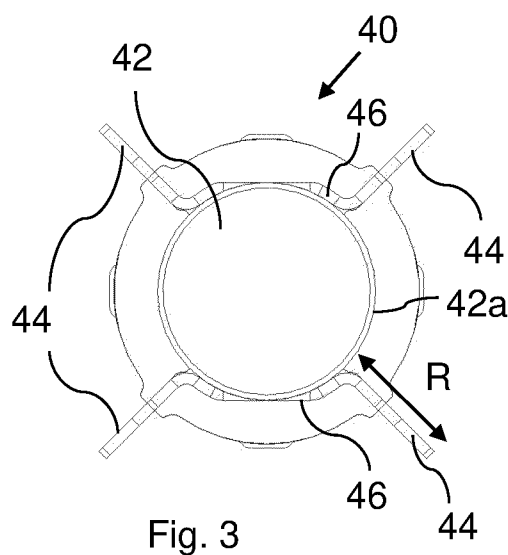


Fig. 2



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER INV. B01D33/04 B01D33/46 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 116 236 841 A (FUQING KING DNARMSA SPIRULINA CO LTD) 9 June 2023 (2023-06-09)	1-6, 8-10, 13-16
A	the whole document -----	11,12
X	DE 10 2004 025115 A1 (KNOLL MASCHB GMBH [DE]) 25 May 2005 (2005-05-25)	1-6, 8-10, 13-16
A	the whole document -----	11,12
X	CN 108 579 173 A (TONGLING CITY YEQIANG ENVIRONMENTAL PROT EQUIPMENT CO LTD) 28 September 2018 (2018-09-28)	1-10, 13-16
A	the whole document ----- -/-	11,12
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 26 August 2024		Date of mailing of the international search report 05/09/2024
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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 214 233 080 U (JIANGSU XINGHONGKAI ENVIRONMENTAL PROT EQUIPMENT CO LTD) 21 September 2021 (2021-09-21) the whole document -----	1 - 16
A	US 2013/264296 A1 (MEJIA ALEJANDRO [US] ET AL) 10 October 2013 (2013-10-10) the whole document -----	1 - 16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/068042

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 116236841 A	09-06-2023	NONE	
DE 102004025115 A1	25-05-2005	DE 102004025115 A1	25-05-2005
		DE 202004008233 U1	16-09-2004
CN 108579173 A	28-09-2018	NONE	
CN 214233080 U	21-09-2021	NONE	
US 2013264296 A1	10-10-2013	CA 2809609 A1	16-09-2013
		US 2013264296 A1	10-10-2013