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(56) Documents Cited
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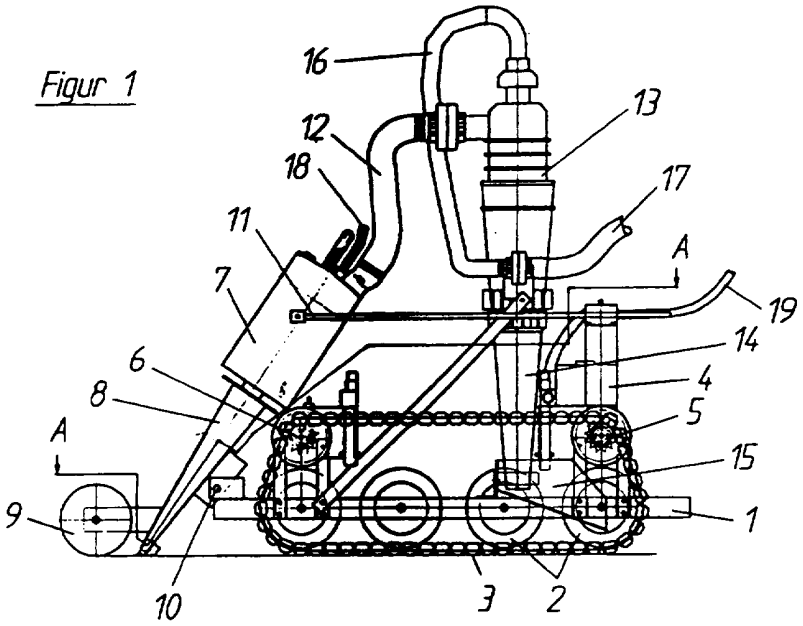
(54) Abstract Title
Cleaning an operative sand bed filter

(57) A method for cleaning the sand in a sand bed filter comprises removing a portion of the top layer of sand, passing the layer through a separator 13, returning the cleaned sand to the filter and discharging the contaminants as an aqueous suspension. The device, for carrying out the method, is preferably remote controlled and comprises a (submersible) pump 7 equipped with a nozzle 8 for sucking up the sand which is then delivered to a separator, preferably a hydrocyclone 13. The sand is preferably returned to the filter bed via spreader plate 15 whilst the contaminant sludge is discharged via hose 17. The device may run on four pairs of double wheels 2 encircled by respective caterpillar tracks 3. The controls may be remotely located with power and signal cables being run through a floating hose to the cleaning device.

Figur 1



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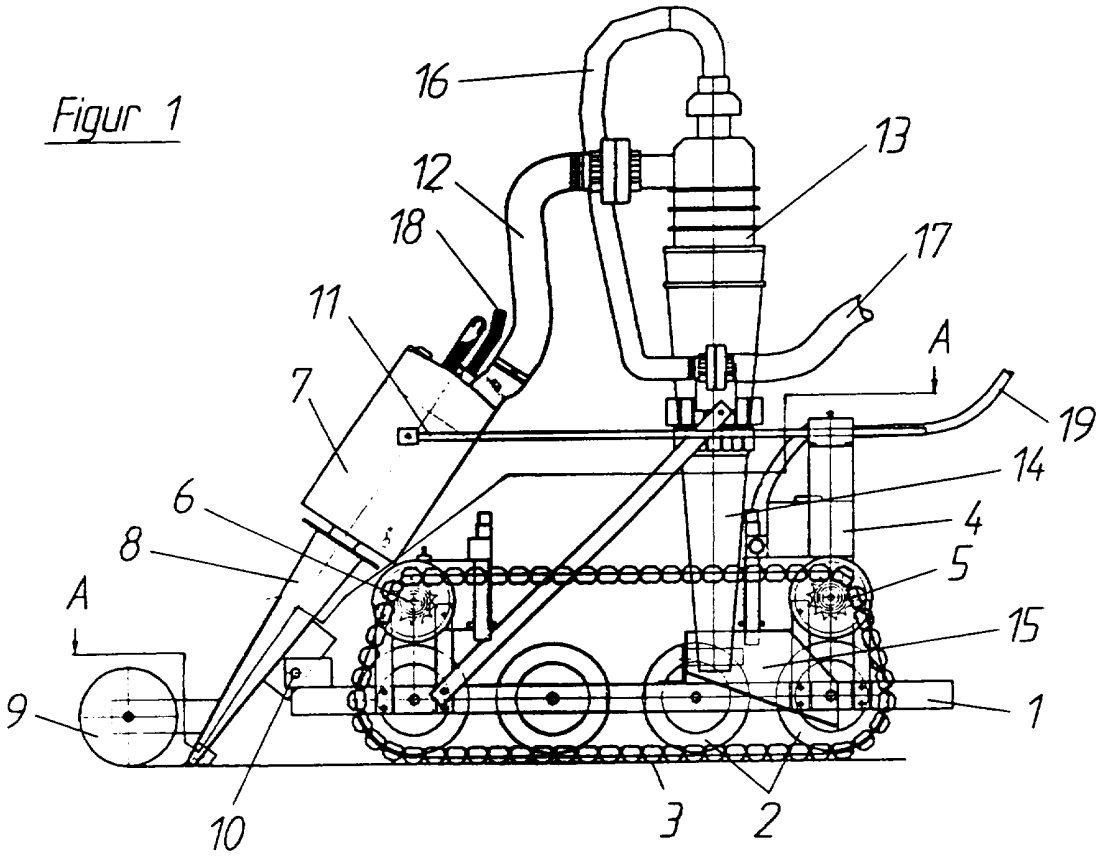
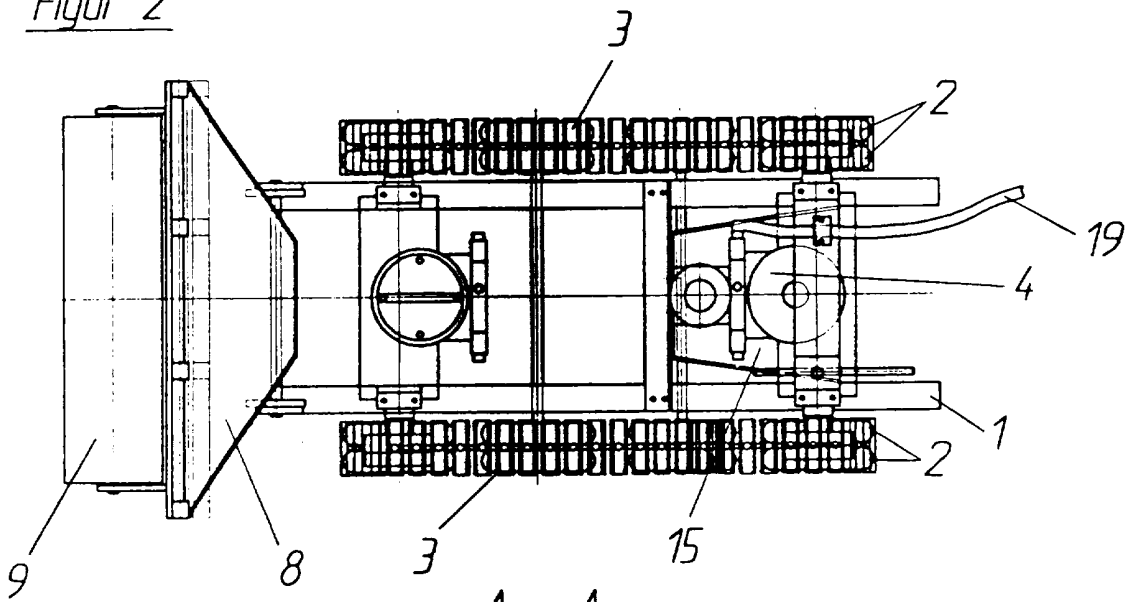
Figur 1



Figur 2



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DESCRIPTION

METHOD AND DEVICE FOR CLEANING BOTTOMS OF POOLS WITH SAND BEDS

The present invention relates to a method, and a device for its implementation, of cleaning the sand beds of slow sand filters, infiltration basins and pools of other types with sand beds in water treatment works and similar plants, while the filter is in service, by removing a few centimeters of the bed surface, cleaning the sand of the sludge, or filter film, formed on the said surface, returning the cleaned sand to the bed, and discharging the separated sludge, suspended in water, to drain or to a suitable disposal site. This is achieved, while the slow sand filter or infiltration basin in question is in service, by traversing the surface of the sand with a tracked cleaning machine in a predetermined pattern which ensures that the entire surface has been traversed by the end of the cleaning operation.

When using previously known methods of cleaning filters or basins of this type, the filter or basin in question must be removed from service and drained of water. A machine, such as a compact loader, is then used to remove the top layer of sand and transport it to a suitable location for cleaning. When the filter is refilled with water following cleaning of the bed, the filtered water must be discharged to waste for two to three weeks before the filter can be returned to normal service, since drying of the sand surface causes disturbance to the microbacterial activity in the bed. Every cleaning

operation of this type takes approximately one month and requires the services of three plant operatives and an outside contractor. Since two bed cleaning operations are normally carried out annually, involving the removal of a total of about 6 centimeters of sand, the filter must be refilled with sand every ten years.

In accordance with a first aspect of the present invention, there is provided a method of cleaning the surface of the sand bed in a slow sand filter, infiltration basin or other type of pool with a sand bed in a water treatment works and the like wherein, while the slow sand filter, infiltration basin or pool in question is still in service a remote-controlled cleaning machine traverses the bed and removes a few centimeters of the top surface with the aid of a submersible pump equipped with a nozzle, for the purpose of cleaning the sand in the top layer of the bed of the sludge, or filter film, formed on it (the bed) in a hydrocyclone and returning the cleaned sand to the bed, while discharging the separated sludge, suspended in water, to waste or to a suitable disposal site through a hose.

In accordance with a second aspect of the present invention, there is provided a device for cleaning the sand bed of a slow sand filter, infiltration basin or other types of pool with a sand bed in a water treatment works and the like, comprising a chassis, caterpillar tracks on the right and left-hand sides of the device respectively, means for selectively driving the left and right caterpillar tracks, a submersible pump having a nozzle at the front of the

device, which widens outwards at the lower end to extend the full width of the machine and is provided with a support roller at the lower end, the pump, nozzle and support roller being adjustable in the vertical direction, the discharge from the pump being by means of a hose connected to a hydrocyclone, the bottom outlet of which discharges to a spreader plate which spreads the clean, separated sand on the sand bed over the full width of the machine, while a pipe connected to a hose is used to discharge the water-suspended sludge from the top outlet of the hydrocyclone.

In accordance with a third aspect of the present invention, there is provided a method of cleaning sand in a submerged sand bed, comprising removing an upper layer of the submerged bed, passing the upper layer through a separator to separate contaminants from the sand, discharging the contaminants suspended in water and returning the cleaned sand to the submerged bed.

In accordance with a fourth aspect of the present invention, there is provided a device for cleaning sand in a submerged sand bed, comprising a submersible nozzle, a pump for removing an upper layer of the submerged bed through the submerged nozzle, separating means for separating contaminants from the sand, means for discharging the contaminants suspended in water, means for returning the cleaned sand to the submerged bed and transport means for moving the nozzle over the submerged bed.

In one embodiment, the invention employs a remote-controlled,

tracked cleaning machine to traverse the surface of the sand bed, while the filter is in service, in a predetermined pattern such that the entire surface has been traversed by the end of the cleaning operation. The machine consists of a chassis equipped with caterpillar tracks and driven by a worm-gear motor. The front of the machine is equipped with a suction nozzle extending the full width of the machine and connected to a submersible pump of a capacity sufficient to remove a layer of sand and sludge approximately 3 centimeters thick, and to convey the material thus removed to a hydrocyclone in which the sand is cleaned and redeposited on the bed behind the machine, while the water-suspended sludge is discharged to waste through a hose. The time required to clean a filter approximately 2,430m^2 in area is approximately 8 hours, including placement of the cleaning machine in, and removal of the machine from, the filter while the unit is in service, representing a very significant saving in time compared with earlier methods.

By way of example only a specific embodiment of the present invention will now be described, with reference to the accompanying drawings, in which:-

Fig. 1 is a side elevation of the cleaning machine; and

Fig. 2 is a horizontal cross-section of the machine through section A-A in Fig. 1.

As shown in Figs. 1 and 2, the chassis 1 is mounted on four pairs of

double wheels 2 encircled, respectively, by right-hand and left-hand caterpillar tracks 3 on each side of the machine. The tracks are driven by a fully-enclosed worm-gear motor 4, which is mounted centrally at the rear of the chassis and which, through a stub axle projecting from either side and provided with a magnetic clutch, drives each set of tracks through an individual chain wheel 5 in engagement with it. The front end of the machine is also equipped with a common shaft with magnetic clutches connected to the chain wheels 6 in engagement with the tracks at the front. The purpose of the magnetic clutches is to release and brake the track on the side towards which the machine is to be steered with turning. The front end of the machine is equipped with a submersible pump 7 provided with a suction nozzle 8, which widens outward at the lower end to extend the full width of the machine. At the lower end, the nozzle is provided with a support roller 9 which rests on the sand bed of the filter. To achieve the required depth of suction in the bed, the pump, suction nozzle and support roller assembly are adjustable in the vertical direction about the hinged joint 10 by means of the adjusting rod 11. The sand, sludge and water extracted from the bed are discharged by the pump through the hose 12 to a hydrocyclone 13, in which the sand is cleaned of the sludge and falls onto a spreader plate 15, from whence it is returned to the filter bed. The water-suspended sludge is discharged to drain or to a suitable disposal site from the top of the hydrocyclone through the pipe 16 and hose 17.

The power supply cables to the pump 7 and worm-gear motor 4, as well as the necessary control wiring, are enclosed in a floating hose 19, which is run to a suitable control station.

To prevent twisting of the floating hose 19 and the discharge hose 17 during the cleaning operation, the machine is operated over the sand bed in a figure-of-eight pattern until the entire surface has been cleaned.

CLAIMS

1. A method of cleaning the surface of the sand bed in a slow sand filter, infiltration basin or other type of pool with a sand bed in a water treatment works and the like wherein, while the slow sand filter, infiltration basin or pool in question is still in service a remote-controlled cleaning machine traverses the bed and removes a few centimeters of the top surface with the aid of a submersible pump equipped with a nozzle, for the purpose of cleaning the sand in the top layer of the bed of the sludge, or filter film, formed on it (the bed) in a hydrocyclone and returning the cleaned sand to the bed, while discharging the separated sludge, suspended in water, to waste or to a suitable disposal site through a hose.

2. A method as claimed in claim 1, wherein a power supply cable for the pump, a power supply cable for forward propulsion of the cleaning machine and control wiring for controlling the machine are housed in a floating hose, which is run to a control station at the side of the slow sand filter or infiltration basin.

3. A device for cleaning the sand bed of a slow sand filter, infiltration basin or other types of pool with a sand bed in a water treatment works and the like, comprising a chassis, caterpillar tracks on the right and left-hand sides of the device respectively, means for selectively driving the left and right caterpillar tracks, a submersible pump having a nozzle at the front of the device, which widens outwards at the lower end to extend the full width of the

machine and is provided with a support roller at the lower end, the pump, nozzle and support roller being adjustable in the vertical direction, the discharge from the pump being by means of a hose connected to a hydrocyclone, the bottom outlet of which discharges to a spreader plate which spreads the clean, separated sand on the sand bed over the full width of the machine, while a pipe connected to a hose is used to discharge the water-suspended sludge from the top outlet of the hydrocyclone.

4. A device as claimed in claim 3, wherein the chassis is mounted on four pairs of double wheels on the right and left-hand sides respectively of the machine, the caterpillar tracks passing round the wheels.

5. A device as claimed in claim 4, wherein the caterpillar tracks are driven by a fully-enclosed worm-gear motor, which is mounted centrally at the rear of the chassis and which, through a stub axle projecting from either side and provided with a magnetic clutch, drives each set of tracks through an individual chain wheel in engagement with it, the front end of the machine also being equipped with a common shaft with magnetic clutches connected to the chain wheels in engagement with the tracks at the front.

6. A device as claimed in any of claims 3 to 5, wherein the pump, nozzle and support roller are adjustable in the vertical direction about a hinged joint by means of an adjusting rod.

7. A method of cleaning sand in a submerged sand bed, comprising removing an upper layer of the submerged bed, passing the upper layer

through a separator to separate contaminants from the sand, discharging the contaminants suspended in water and returning the cleaned sand to the submerged bed.

8. A device for cleaning sand in a submerged sand bed, comprising a submersible nozzle, a pump for removing an upper layer of the submerged bed through the submerged nozzle, separating means for separating contaminants from the sand, means for discharging the contaminants suspended in water, means for returning the cleaned sand to the submerged bed and transport means for moving the nozzle over the submerged bed.

9. A method of cleaning the surface of a sand bed, substantially as herein described, with reference to, and as illustrated in, the accompanying drawings.

10. A device for cleaning sand in a submerged sand bed, substantially as herein described, with reference to, and as illustrated in, the accompanying drawings.

Application No: GB 9907763.8
Claims searched: 1, 2, 7 and 8

Examiner: Steve Wintersgill
Date of search: 29 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): B01D 24/20, 24/30, 24/46, 36/04, 41/02

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2,151,153 A	(VEB PROJEKTIERUNG) see whole document, especially Figures 7 and 8.	7 and 8.
X	EP 0,509,345 A2	(FORSCHUNGSZENTRUM) see whole document.	7 and 8.
X,Y	EP 0,310,221 A1	(THAMES WATER) see whole document.	X:7 and 8. Y:1 and 2.
Y	US 4,670,139 A	(SPRUIELL) see especially column 8 lines 9 to 27.	1 and 2.
Y	US 3,764,008 A	(DARLEY) see especially column 2 lines 31 to 54.	1 and 2.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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