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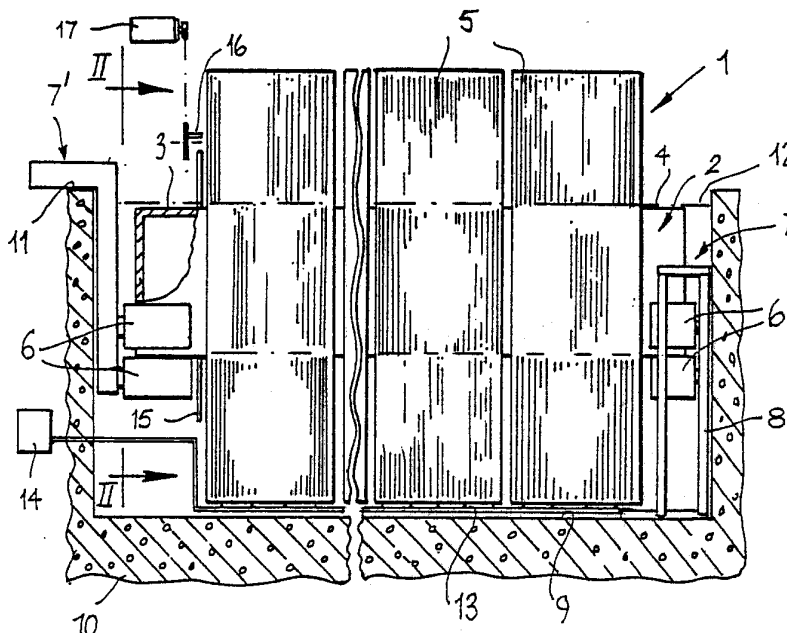
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(54) Title: IMPROVEMENTS IN RBC WASTE-WATER TREATMENT PLANT



(57) Abstract

A waste water treatment plant comprising a biological contactor rotor (1) having a shaft (2) rotatably supported in a waste water tank (10). The shaft of the rotor is supported at each end from below by a cradle of rolling members (6) into which the shaft ends are lowered. The rotor can be turned by a motor (17) or by air from a blower (14).

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IMPROVEMENTS IN RBC WASTE-WATER TREATMENT PLANTTechnical Field

This invention relates to waste-water treatment plant that utilises a rotating biological contactor (or RBC) to provide a large area biomass support surface on which biological break-down of pollutants entrained
5 in waste water can occur.

Discussion of Prior Art

It is known to provide many hundreds of square metres of biomass support surface in a waste-water treatment plant, by securing packs of profiled plastics sheeting around a central support shaft to make a cylindrical
10 rotor, to partially submerge the rotor in waste water to be treated and to rotate the rotor so that areas thereof are sequentially submerged (to pick up biomass from the waste water) and exposed to the atmosphere (to permit the desired enzyme action on the biomass to proceed
15 at an advantageous rate).

An RBC for a large waste-water treatment plant could be over 5 metres in diameter and over 8 metres in length and when fully loaded with wet biomass could weigh in excess of 60,000 Kg. The support of the shaft of a rotor
20 of this size in a waste-water tank poses problems.

It has recently been proposed in US-A-4522714 (Thissen) to make the shaft of an RBC as a closed hollow volume and of a size such that it will impart significant buoyancy to the rotor and then to support the shaft in
25 the tank via sub-shafts, projecting from opposite ends of the shaft, in end bearings mounted in the tank. The bearings for the sub-shafts can be mounted on frames resting on the bottom of the waste-water tank adjacent to opposite ends thereof or the bearings can be suspended
30 from hangers depending from tank wall-mounted brackets.

The provision of sub-shafts increases the manufacturing cost of the rotor and inevitably provides weakened

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regions of the shaft at which fatigue cracks can form leading to premature fracture of the shaft.

Summary of the Invention

According to this invention the shaft of an RBC is supported from below within the tank of a waste-water treatment plant by at least two rolling members at each end of the shaft, the at least two rolling members at each end defining a cradle into which the shaft end can be lowered to rotatably rest.

The rolling members could be an arcuate array of balls but preferably cylindrical rollers are used.

Conveniently there are three axially parallel rollers defining each cradle and suitably the rotating axes of the three rollers and the rotating axis of the shaft define the corners of a quadrilateral which is symmetrical about the diagonal thereof which connects the axis of the shaft with the rotating axis of the lowest roller. The semi-angle between the said diagonal and each side of the quadrilateral that passes through the shaft axis, conveniently lies between 20° and 70° and preferably between 30° and 60° . Four or five rollers can also be used to define each cradle.

Preferably the cradle of rolling members at each end of the shaft is disposed so that the upper surface of the shaft is at or close to the normal free surface of waste water in the tank, however the percentage immersion of the shaft may vary from 65 to 100%, depending upon the process application. Suitably the shaft is a closed hollow volume so that the weight of water it displaces exceeds the weight of the shaft and also assists in providing additional buoyancy to an extent that it substantially reduces the effective weight of the rotor when loaded with biomass and when immersed in water.

Each cradle of rolling members can be supported

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from the bottom of the tank or it can be hung in the respective end of the tank from an exposed upper surface of an adjacent tank wall.

In addition to the provision of rolling members
5 to support the residual weight of the rotor in the tank, further rolling members may be provided to ensure axial positioning of the rotor shaft in the tank.

Where rollers are used for the rolling members, the diameters of the rollers making up each cradle are
10 suitably between one half and one tenth of the diameter of the shaft and the length of each roller is suitably between 100 and 300 mm.

The shaft can be between 500 and 1500 mm in diameter and the rotor can be submerged to between 65 and 100%
15 of the available area of the biomass support surface.

The rotor can be driven by air bubbled into the tank below the rotor (as described in US-A-3886074), by one or more of the rolling members making up each cradle being driven, or by a motorised drive member (e.g.
20 a chain, toothed or pegged wheel) engaging the periphery of the rotor or a drive flange attached to the shaft.

Brief Description of the Drawings

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

25 Figure 1 is a side elevation of the RBC of a waste-water treatment plant supported in a tank in accordance with the invention in different ways on the left- and right-hand sides, and

Figure 2 is a sectional view on the line II-II in
30 Figure 1.

Description of Preferred Embodiments

An RBC 1 comprises a hollow shaft 2 surrounded,

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apart from over two end regions 3 and 4, with an annular array 5 of packs of plastics sheeting profiled to provide a multitude of channels for water and air flow to the interior of the packs and to provide a total biomass support area in excess of 20,000 square metres. The packs of plastics sheeting can be mounted in radially extending supporting frames in the manner described in the specification of European Patent Application 85309188.2 filed 17th December 1985.

Each end 3 or 4 of the shaft 2, is supported in a cradle of rollers 6 freely journaled from a suitable roller support means 7. On the right-hand side of Figure 1, the support means 7 is a frame 8 resting on the base 9 of a tank 10 containing the RBC 1 and on the left-hand side the support means (here designated 7') depends from an upper wall 11 of the tank 10.

Since the shaft 2 merely rests in the cradle of rollers 6 (see Figure 2) it can readily be removed for servicing/repair by lifting it off the cradles at each end. Any roller 6 that becomes defective can be removed and replaced, by temporarily taking the load of the shaft off the cradle at the end where a replacement roller is required while effecting roller replacement within the tank (usually with a reduced water level therein). The normal water level is shown at 12 in Figures 1 and 2.

Figure 1 also shows two alternative ways of rotating the RBC 1. Firstly, in the bottom of the tank 10, air nozzles 13 can be located, through which air from a blower 14 issues to be trapped on the ascending side of the rotor and thus generate a turning moment. Secondly, on one end of the shaft 2 a toothed flange 15 is mounted which engages a rotating peg 16 driven by a motor 17. Clearly other drive mechanisms can be evolved.

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Figure 2 shows, in dotted lines, two additional rollers 6' which make a cradle of five rollers in all. This may be desirable with the heaviest rotors.

To prevent axial movement of the shaft in the tank one or more of the rollers at each end can be flanged so that the end of the shaft bears against the roller flange(s). Alternatively a further roller can be provided (e.g. with its axis vertical) at each end to bear against the respective end of the shaft.

The invention appears to be particularly applicable to rotors with diameters between two and six metres and axial lengths of up to eight and a half metres.

To overcome possible problems caused by shaft deflection if a rotor loaded with biomass is left in a drained tank some means may be provided to prevent excessive deflection of the shaft between its end supports.

Thus, for example, one or more cradles can be provided to rest on the bottom of the tank between adjacent arrays 5, the upper edge of each cradle having a surface which does not contact the shaft 2 under normal loading conditions of the latter. An alternative to a cradle supporting from below would be a chain or hawser looped below the shaft at one or more points between the end rollers.

To lift the RBC from the tank, it may be desirable to provide lifting lugs at each end and at least one similar lug uniformly spaced-apart between the end lugs. The lifting lugs can then be engaged by lifting bars or cables depending from a spreader bar when lifting of the RBC is required.

A treatment plant according to this invention can

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be used for sewage treatment and also for carbonaceous BOD removal, nitrification and denitrification applications.

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CLAIMS

1. A waste water treatment plant comprising a tank and a biological contactor rotor providing a large area biomass support surface having a shaft rotatably supported within the tank so that the support-surface thereof is only partly submerged in waste water within the tank and means to turn the rotor so that areas of the biomass support surface thereof are sequentially submerged in waste water and exposed to the atmosphere, characterised in that the shaft is supported within the tank from below by at least two rolling members at each end of the shaft, the at least two rolling members at each end defining a cradle into which the shaft end can be lowered to rotatably rest.

2. A treatment plant as claimed in claim 1, characterised in that the rolling members are an arcuate array of cylindrical rollers.

3. A treatment plant as claimed in claim 2, characterised in that there are three axially parallel rollers defining each cradle and the rotating axes of the three rollers and the rotating axis of the shaft define the corners of a quadrilateral which is symmetrical about the diagonal thereof which connects the axis of the shaft with the rotating axis of the lowest roller.

4. A treatment plant as claimed in claim 3, characterised in that semi-angle between the said diagonal and each side of the quadrilateral that passes through the shaft axis, lies between 20° and 70° and preferably between 30° and 60°.

5. A treatment plant as claimed in claim 1, characterised in that the cradle of rolling members

at each end of the shaft is disposed so that the upper surface of the shaft is at or close to the normal free surface of waste water in the tank.

5 6. A treatment plant as claimed in claim 1,
characterised in that the shaft is a closed hollow
volume so that the weight of water it displaces exceeds
the weight of the shaft and also assists in providing
additional buoyancy to an extent that it substantially
10 reduces the effective weight of the rotor when loaded
with biomass and when immersed in water.

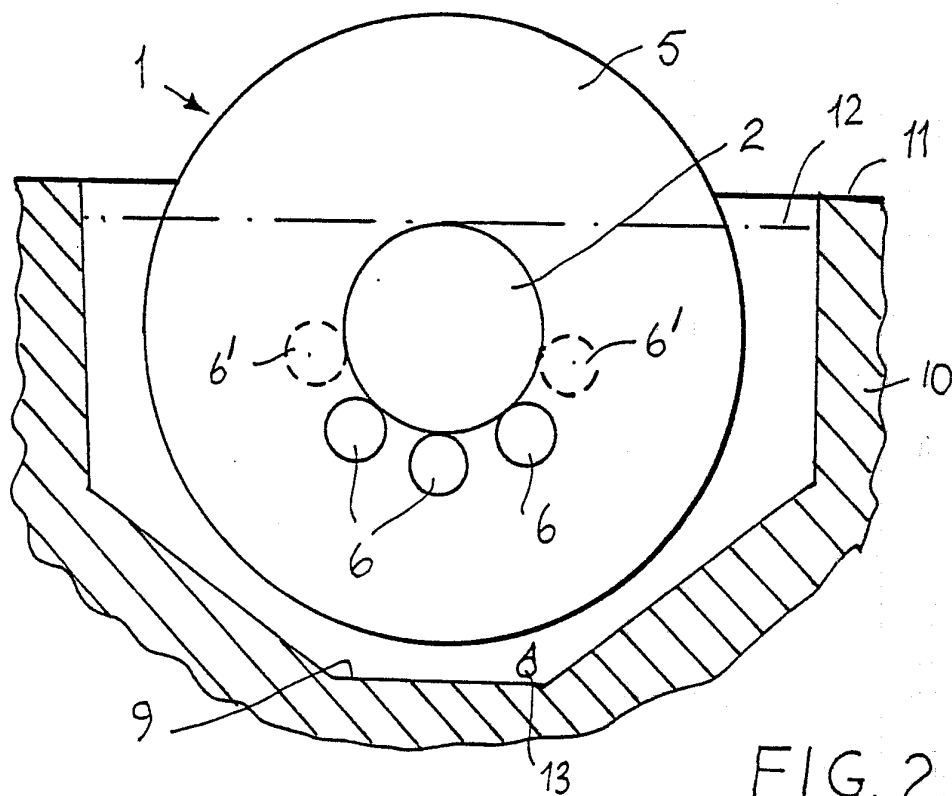
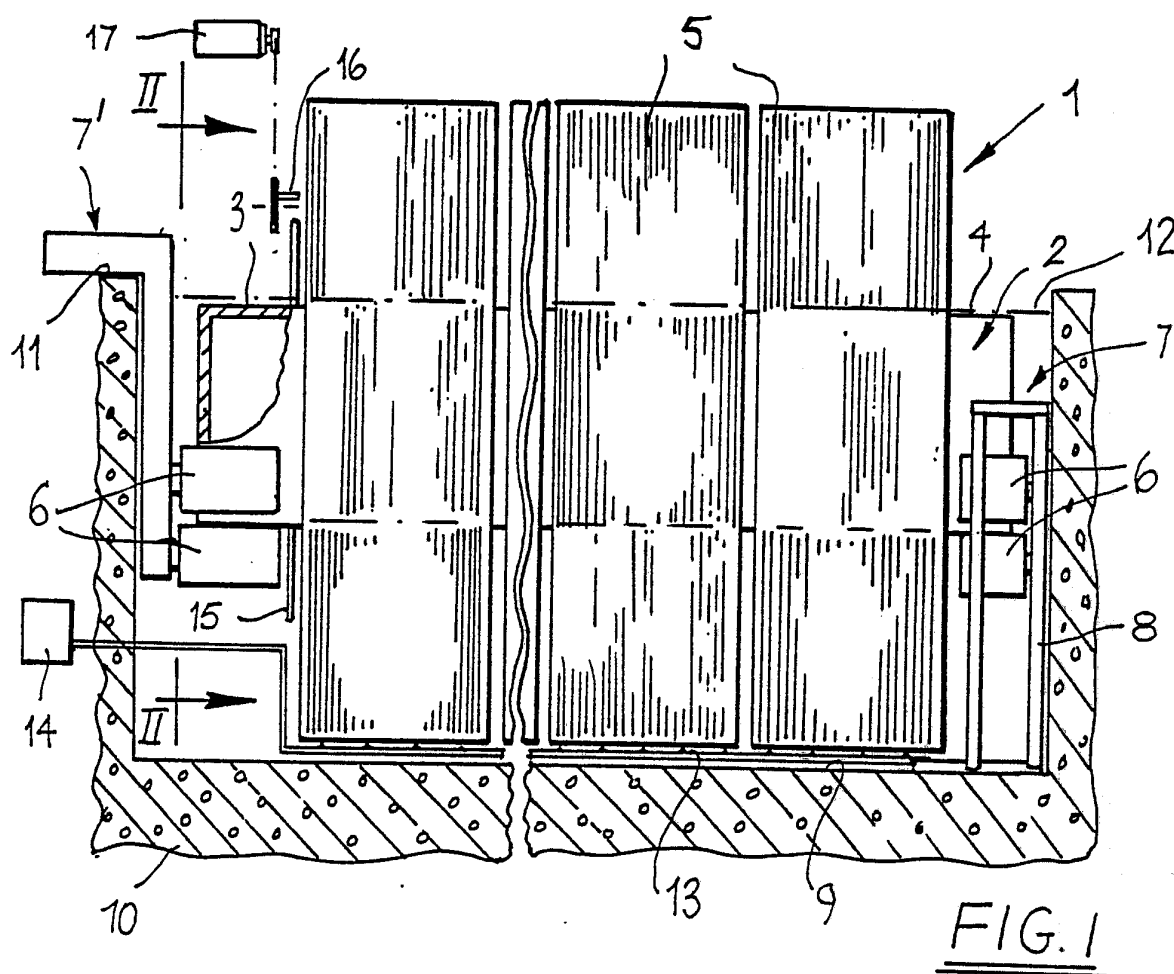
7. A treatment plant as claimed in claim 1,
characterised in that each cradle of rolling members
is hung in the respective end of the tank from an ex-
posed upper surface of an adjacent tank wall.

15 8. A treatment plant as claimed in claim 1,
characterised in that in addition to the provision
of rolling members to support the residual weight of
the rotor in the tank, further rolling members are
provided to ensure axial positioning of the rotor shaft
20 in the tank.

9. A treatment plant as claimed in claim 2,
characterised in that the diameters of the rollers
making up each cradle are between one half and one
tenth of the diameter of the shaft.

25 10 A treatment plant as claimed in claim 1,
characterised in that the rotor is rotatably driven
by a motorised drive member engaging the periphery
of a drive flange attached to the shaft.

30 11. A treatment plant as claimed in claim 1,
characterised in that the rotor is rotatably driven
by air bubbled into the tank below the rotor.



SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 87/00271

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁴ : C 02 F 3/08; F 16 C 13/04		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁴	C 02 F; F 16 C	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 4256580 (MECAFINA) 17 March 1981 see front-page, abstract; column 2, lines 24-39; column 2, line 67 - column 4, line 5	1,10
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A	US, A, 3886074 (AUTOTROL) 27 May 1975 see front-page, abstract	11

¹⁰ Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
1st July 1987		27 JUL 1987
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		M. VAN MOL 

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO.

PCT/GB 87/00271 (SA 16984)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/07/87

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4256580	17/03/81	DE-A- 2710071	24/05/78
		CH-A- 602496	31/07/78
		GB-A- 1543670	04/04/79
		JP-A- 53047159	27/04/78
		AT-B- 354368	27/12/79
US-A- 3886074	27/05/75	NL-A- 7408017	17/12/74
		BE-A- 816248	13/12/74
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