附件 2

单一来源采购方式专家论证意见

专家信息	姓名：郭永杰	工作单位：云南磷化集团
	职称：正高级工程师	职务：
项目信息	项目名称：矿物加工工程试验平台建设“双一流”	
	供应商名称：　**昆明奥斯顿科技有限公司**	
专家论证意见	美卓奥图泰实验室浮选机，GTK labcell™配备自动刮泡机构，可最大限度地减少操作员操作对浮选实验的影响。叶轮速度和空气流速可调，以产生足够的固体悬浮液和气体分散。除浮选实验外，该功能机还可用于磨损、混合、搅拌和脱泥实验。 奥图泰公司Pori研发中心自主研发设计的HSC chemistry软件，是具有热力学计算与流程模拟等功能的知名软件。 上述相关产品，由于是具有相关专利保护，其他企业无法生产，只能采用单一来源方式采购该产品	
专家签字	郭永杰	签字日期　　年　月　日

注：本表格中专家意见由专家手工填写。

附件2

单一来源采购方式专家论证意见

专家信息	姓名：万小金	工作单位：中国铜业有限公司
	职称：正高级工程师	职务：
项目信息	项目名称：矿物加工工程试验平台建设"双一流"	
	供应商名称：**昆明奥斯顿科技有限公司**	
专家论证意见	奥图泰公司长期从事浮选设备的设计和研发，其所设计的奥图泰"GTK LabCell"实验浮选机转子和定子已获得专利技术。其搅拌机构(组合的定子与转子)固定位置可轻微调节；该浮选机可根据不同的槽体配套选择对应的转子与定子的组合；搅拌强度可调同时保证矿浆内的高效悬浮和循环，矿浆流动平稳，有利于各个粒级矿物的选别；可实现准确控制且实验重复性好；采用数字化控制系统，可精准数字化控制刮泡频次、充气量和转子转速。 奥图泰公司Pori研发中心自主设计的HSC Chemistry软件，具有热力学计算与流程模拟等功能的多功能软件。 上述相关产品，由于具有相关专利保护，其它企业无法生产；只能采用单一来源方式采购产品。	
专家签字	万小金	签字日期　　　年　月　日

注：本表格中专家意见由专家手工填写。

附件 2

单一来源采购方式专家论证意见

专家信息	姓名：冉银华	工作单位：云南科力环保股份公司
	职称：正高级工程师	职务：
项目信息	项目名称：矿物加工工程试验平台建设“双一流”	
	供应商名称：**昆明奥斯顿科技有限公司**	
专家论证意见	美卓奥图泰实验室浮选机配备了自动刮泡机构，可最大限度减少操作对浮选实验的影响，同时该机还具有热力学计算与流程模拟等功能，对提高实验精度有益，对“双一流”试验平台的建设具有积极的意义。 由于该机有专利保护，其它企业无法生产，同时产品也不属于禁止、限制进口产品，参照招采管理相关规定，可以采用“单一来源”方式进行采购。	
专家签字	冉银华	签字日期　　年　月　日

注：本表格中专家意见由专家手工填写。

单一来源采购方式专家论证意见

所属情形	☑ 新购买的设备产权保护（独家拥有专利）产品只能由特定供应商制造或者提供货物和服务，且不存在任何其他合理的选择或替代情况。
项目信息	项目名称：矿物加工工程试验平台建设“双一流”
	预算金额：96 万元
	供应商名称：昆明奥斯顿科技有限公司
专家论证综合意见	鉴于现有的美卓奥图泰（GTK LabCell）浮选机自动化程度高，有助于“双一流”平台建设，可促进学科教学科研能力的提升。美卓奥图泰的GTK LabCell实验室浮选机可以完全取代国内传统的小型浮选机，减少试验工作量，并帮助科研人员和学生找到最佳操作条件，使浮选指标稳定，且奥图泰公司长期从事浮选设备的设计和研发，其所设计的浮选机已获得专利技术。 上述相关产品，由于具有相关专利保护，其他企业无法生产，故同意采用单一来源方式采购该产品。
专家组签字	冉银华 郭永杰 万小金 | 签字日期：2023年3月5日

注：本表格中专家意见由专家手工填写。

Metso:Outotec

美卓奥图泰业务授权书

昆明理工大学领导：

为了更好的服务客户，同时贯彻美卓奥图泰业务发展的整体要求，针对此次贵校采购美卓奥图泰实验室浮选机产品，特授予昆明奥斯顿科技有限公司为此次唯一的单一来源指定经销商。

2022 年 6 月 20 日

美卓奥图泰国际贸易（天津）有限公司

美卓奥图泰专利一：一种浮选机定子

发明者：Sami Groenstrand，Raimo Ariola，Seppo Ronkainen
代理人：奥图泰公司
专利编号：US7,458,467 B2
专利时间：2008年12月2日

摘要：

该项专利发明的定子为用于矿浆类如矿石、精矿等包含有用矿物的浮选机上使用，其由该定子可使浮选机转子产生的矿浆流的方向受控。该定子由至少三个结构元素组成安装在转子的周围，并自带至少一个流体调节器。

US007458467B2

(12) United States Patent
Grönstrand et al.

(10) Patent No.: **US 7,458,467 B2**
(45) Date of Patent: **Dec. 2, 2008**

(54) **STATOR FOR A FLOTATION CELL**

(75) Inventors: **Sami Grönstrand**, Espoo (FI); **Raimo Airola**, Espoo (FI); **Seppo Ronkainen**, Kauniainen (FI)

(73) Assignee: **Outotec Oyj**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 57 days.

(21) Appl. No.: **10/598,757**

(22) PCT Filed: **Mar. 31, 2005**

(86) PCT No.: **PCT/FI2005/000168**

§ 371 (c)(1),
(2), (4) Date: **Sep. 11, 2006**

(87) PCT Pub. No.: **WO2005/097334**

PCT Pub. Date: **Oct. 20, 2005**

(65) **Prior Publication Data**

US 2007/0181468 A1 Aug. 9, 2007

(30) **Foreign Application Priority Data**

Apr. 6, 2004 (FI) 20040498

(51) **Int. Cl.**
B03D 1/16 (2006.01)

(52) **U.S. Cl.** **209/169**; 209/168

(58) **Field of Classification Search** 209/169, 209/168
See application file for complete search history.

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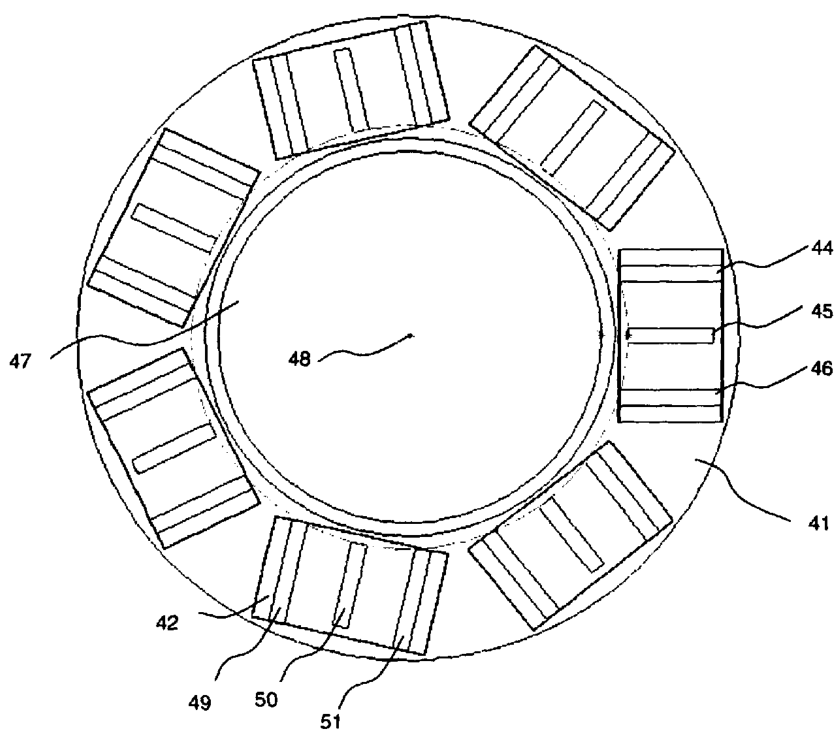
Primary Examiner—Thomas M Lithgow
(74) *Attorney, Agent, or Firm*—Smith-Hill and Bedell

(57) **ABSTRACT**

The invention relates to a stator for a flotation cell to be used in the flotation of slurry-like material, such as ore and concentrate containing valuable minerals, by means of which stator the orientation of the slurry flow created by the flotation cell rotor can be controlled. The stator is composed of at least three structural elements to be installed around the rotor provided with at least one flow regulator.

7 Claims, 2 Drawing Sheets



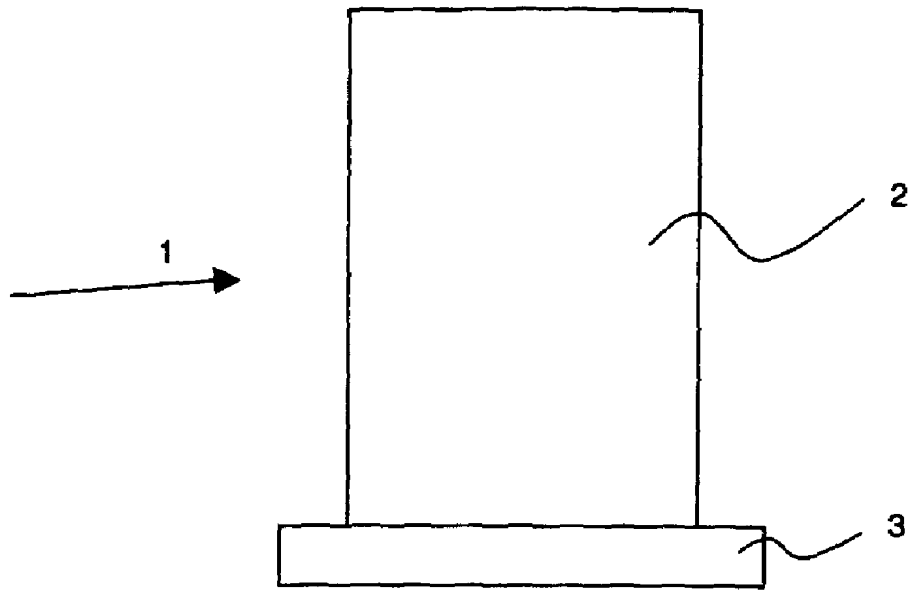


Fig. 1

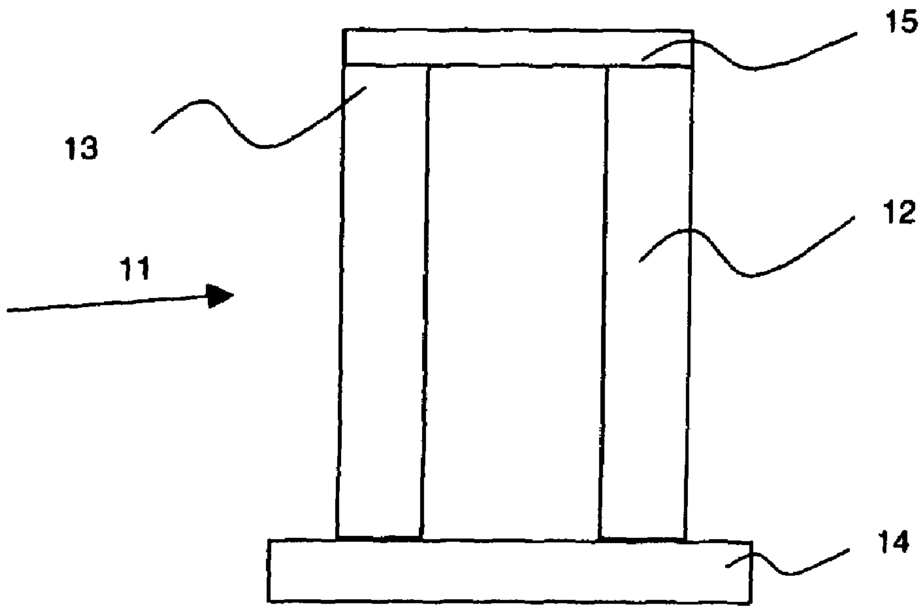


Fig. 2

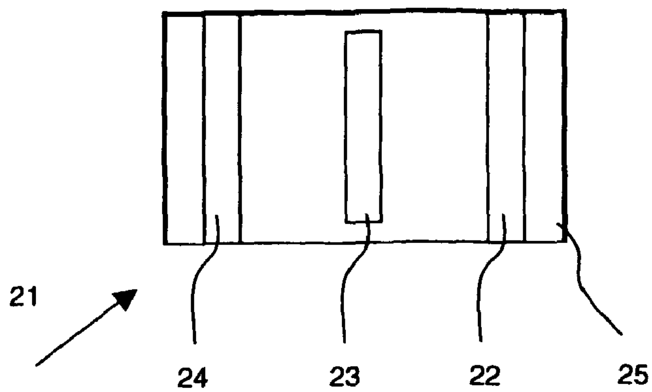


Fig. 3

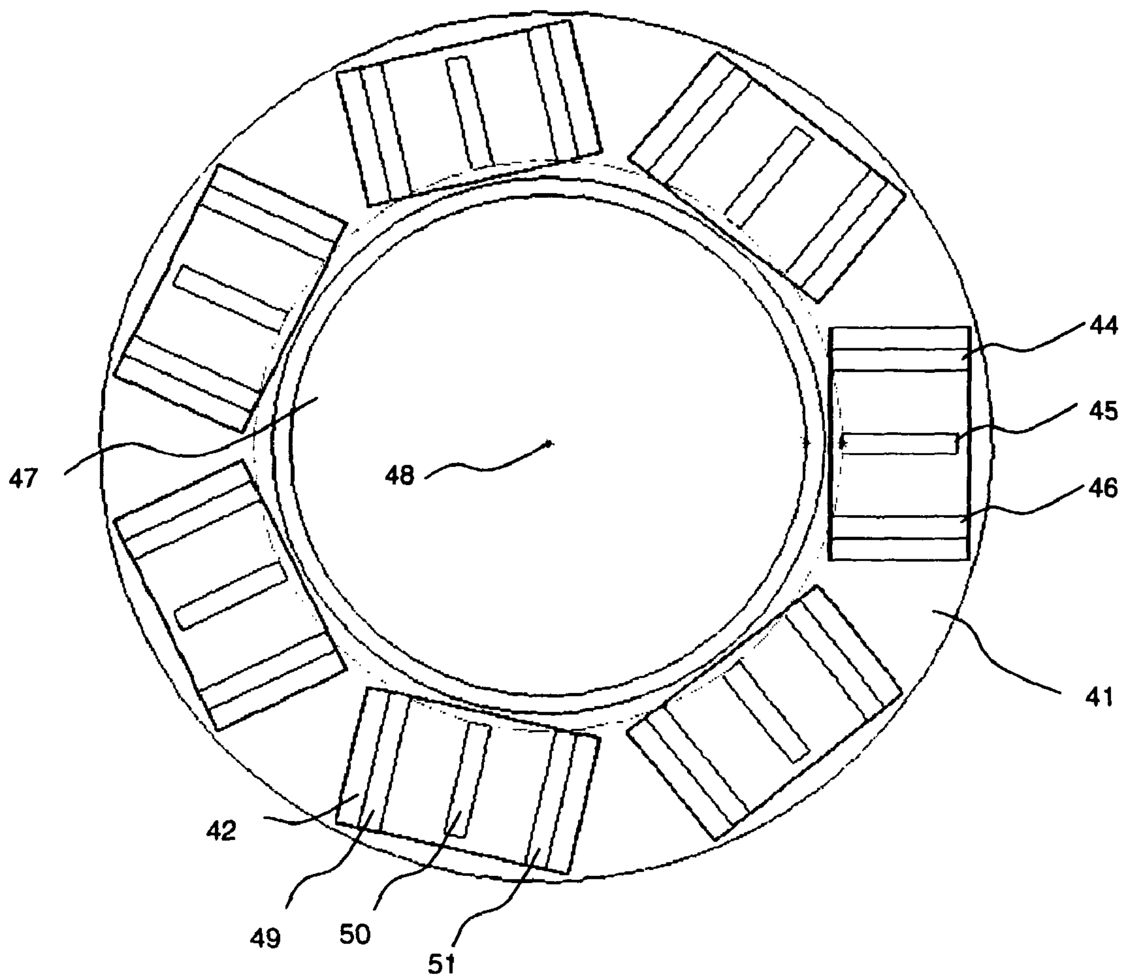


Fig. 4

STATOR FOR A FLOTATION CELL

This is a national stage application filed under 35 U.S.C. 371 based on International Application No. PCT/FI2005/000168 filed Mar. 31, 2005, and claims priority under 35 U.S.C. 119 of Finnish Patent Application No. 20040498 filed Apr. 6, 2004.

The present invention relates to a stator for a flotation cell to be used in the flotation of slurry-like material, such as ore and concentrate containing valuable minerals, by which stator the slurry flow created by the rotor of the flotation cell can be advantageously directed towards at least one of the flow regulating members of the stator, so that the slurry jet is prevented from flowing directly through the stator.

A flotation machine used in the recovery of valuable ingredients usually includes a flotation cell provided with an inlet aperture for feeding slurry into the cell, and an outlet aperture for the non-flotatable material to be discharged from the flotation cell. The air needed for creating froth is fed through a hollow, rotatable axis, which axis is connected to an agitator element that agitates the slurry in order to keep it in suspension. When the rotor serving as the agitator rotates, air is fed in the slurry, and air bubbles are dispersed in the slurry. The stator installed around the rotor guides the circulations of the suspension formed by slurry and air. In addition, reagents are fed into the flotation cell, which reagents are then attached onto the surface of the valuable particles that are contained in the slurry and should be recovered. The reagents make the valuable particles hydrophobic and thus enhance the valuable particles to be attached to air bubbles. As the valuable particles are attached to the air bubbles, the particles start to rise upwards, towards the free top surface of the flotation cell, and there form a stabile froth bed.

For example the U.S. Pat. No. 5,039,400 and the PCT patent applications 01/43881 and 01/49388 describe a flotation cell used for flotating ore and concentrate containing valuable minerals, wherein a stator is installed around the rotor. The stator includes spaced-apart flow regulating members that are interconnected at least by a frame structure provided at the bottom part of the regulating members. This kind of a stator formed of flow regulating members and a frame is manufactured of one piece, and consequently, as the flotation cell sizes have grown, also the stator has become an essentially large object that is heavy and troublesome to handle, which as such increases expenses.

The object of the present invention is to eliminate drawbacks of the prior art and to realize an improved stator for a flotation cell used in the flotation of valuable minerals, which stator is easier to handle and is composed of structural elements including one or several flow regulating elements of the stator. The essential novel features of the invention are apparent from the appended claims.

A flotation cell stator with a modular structure according to the invention comprises at least three structural elements included in at least one flow regulator. The stator is advantageously composed of essentially identical structural elements, but the stator can also be composed so that the stator includes different structural parts provided with different numbers of flow regulators. The structural elements of the stator can also be arranged so that the structural elements are placed on top of each other, on two different levels. In addition, by changing the number of the structural elements of the stators, it is possible to provide stators that are by volume suitable for different sizes of flotation cells. Irrespective of the size of the flotation cell stator according to the invention, the structural elements are mutually arranged so that the tangential slurry jet emitted from the flotation cell rotor can be directed preferably towards at least one flow regulator of the stator in order to prevent the slurry jet from flowing directly through the stator.

In cross-section, the flow regulator of the stator according to the invention of a flotation cell with a modular structure is preferably oval-shaped or elliptical or even rectangular, where the ratio of the larger dimension to the smaller is preferably at least bigger than three. The flow regulator is provided with a supporting structure, whereby the flow regulator can be attached to the flotation cell or to a separate stator fastening structure installed in the flotation cell, so that the flow regulator can be advantageously aligned with respect to the rotor provided in the flotation cell. The flow regulator and the connected supporting structure constitute a single structural element of the stator according to the invention. By combining said structural elements, there is obtained a stator of the desired size.

One or several flow regulators can be connected to a supporting structure provided in a single structural element of the stator. From the point of view of the manufacturing and treatment of the structural element, it is advantageous that the number of flow regulators provided in each supporting structure is no more than five. According to a preferred embodiment of the invention, three flow regulators are connected to each supporting structure, so that the flow regulator placed in the middle is located essentially equidistantly from the two other flow regulators. In addition, in cross-section the middlemost flow regulator is advantageously different from the two other flow regulators, so that the ratio of the larger and smaller dimensions of the cross-section is smaller than in the two other flow regulators. Now, when installing the structural element around the rotor of the flotation cell, that edge of the middlemost flow regulator that is nearest to the rotation axis of the rotor is arranged, in the radial direction, at an essentially equal distance from the rotation axis as the corresponding edge of the two other flow regulators.

When the supporting structure includes only one flow regulator, this kind of structural element of the stator can advantageously be manufactured in one piece, for example by casting. A structural element including one flow regulator can also be manufactured so that both the flow regulator and the supporting structure to be connected thereto are manufactured separately, for example by casting, hot extrusion or even by forging. Thereafter the flow regulator is connected to the supporting structure by welding or soldering or even mechanically, for instance by a screw joint.

When several flow regulators should be installed in the supporting structure, both the flow regulators and the supporting structure are advantageously manufactured separately and connected to the supporting structure of the flow regulators in a similar way as in the case of one single flow regulator. However, when desired, a structural element of the stator containing two or more flow regulators can also be manufactured as one piece, for example by casting. When several flow regulators are arranged in one and the same supporting structure, the flow regulators can also be interconnected at that end of the flow regulators that is opposite with respect to the supporting structure, in which case in that end of the flow regulators that is opposite to the supporting structure, there is attached for example a connecting element that is essentially similar to the supporting structure. The connecting element arranged at the end opposite to the supporting structure can also be essentially different from the supporting structure; for instance, it can be a connecting element that is essentially thinner and lighter than the supporting structure. The flow regulators interconnected at the end opposite to the supporting structure are better resistant to the strains caused by the solids-containing slurry treated in the flotation cell.

When manufacturing, according to the invention, the structural element of the stator, made of one or several flow regulators and supporting material, as well as possibly of a connecting element attached at the end opposite to the supporting structure of the flow regulator, the desired final structural element is coated for example by rubber lining, in order to make the structural element better resistant to the wearing effects of the slurry material treated in the flotation cell and containing solids, such as valuable metals.

The invention is described in more detail below, with reference to the appended drawings, where

FIG. **1** is a schematical side-view illustration of a preferred embodiment of the invention,

FIG. **2** is a schematical side-view illustration of another preferred embodiment of the invention,

FIG. **3** is a schematical top-view illustration of a preferred embodiment of the invention, and

FIG. **4** is a schematical top-view illustration of a stator according to the invention, composed of structural elements.

According to FIG. **1**, the structural element **1** of the stator, used in a flotation cell, is formed of one flow regulator **2** and of a supporting structure **3** attached to the other end of the flow regulator **2**, whereby the flow regulator **2** can be connected to the flotation cell or to a stator fastening structure installed in the flotation cell. The flow regulator **2** and the supporting structure **3** are further both coated by a wear-resistant rubber lining.

The structural element **11** of the stator illustrated in FIG. **2** includes two flow regulators **12** and **13**. At the other end, the flow regulators **12** and **13** are interconnected by a supporting structure **14** common to the flow regulators **12** and **13**, by means of which supporting structure **14** the flow regulators **12** and **13** can be connected to the flotation cell or to a stator fastening structure installed in the flotation cell. At that end of the flow regulators **12** and **13** that is opposite to the supporting structure **14**, there is installed a connecting element **15**, whereby the flow regulators **12** and **13** are also interconnected. The structural element **11** composed of the flow regulators **12** and **13**, the supporting structure **14** and the connecting element **15** is manufactured by casting, preferably in one piece.

According to FIG. **3**, the stator structural element **21** used in a flotation cell includes three flow regulators **22**, **23** and **24**. At one end, the flow regulators **22**, **23** and **24** are interconnected by a supporting structure **25**. By means of the supporting structure **25**, the flow regulators **22**, **23** and **24** can be advantageously interconnected to the flotation cell or to a stator fastening structure installed in the flotation cell. With respect to the supporting structure **25**, the flow regulators **22**, **23** and **24** are installed so that the middlemost flow regulator **23** is located at an essentially equal distance both from the flow regulator **22** and from the flow regulator **24**. In cross-section, the flow regulators **22** and **24** are designed to be essentially identical. On the other hand, the middlemost flow regulator **23** differs from the flow regulators **22** and **24** in cross-section, so that in the middlemost flow regulator **23**, the ratio of the larger dimension to the smaller dimension is smaller than in the cross-section of the flow regulators **22** and **24**.

The stator **41** illustrated in FIG. **4** is composed of structural elements **42** according to the invention, each of which elements includes three flow regulators **44**, **45** and **46** arranged in the same supporting structure **43**. The structural elements **42** are arranged around the rotor **47** of the flotation cell, so that the edges **49**, **50** and **51** of the flow regulators **44**, **45** and **46** placed nearest to the rotor rotation axis **48** are located at an essentially equal distance from the rotor rotation axis **48**.

The invention claimed is:

1. A flotation cell for use in the flotation of slurry-like material, such as ore and concentrate containing valuable minerals, the flotation cell comprising:

a rotor mounted to rotate about an axis, and

a stator including at least three structural elements angularly spaced apart around the rotor,

wherein each structural element has first and second opposite ends and comprises at least two flow regulators, a supporting structure that is attached to and interconnects the flow regulators at the first end of the structural element and by which the structural element is connected to the flotation cell or to a stator fastening structure in the flotation cell, and a connecting element interconnecting the flow regulators at the second end of the structural element,

the flow regulators of each structural element are disposed substantially parallel to each other,

and a structural element is manufactured by separately casting the flow regulators, the supporting structure and the connecting element, assembling the flow regulators, the supporting structure and the connecting element to form the structural element, and interconnecting the flow regulators, the supporting structure and the connecting element by welding.

2. A flotation cell according to claim **1**, wherein the flow regulators of each structural element are interconnected by the supporting structure, which is attached to the flow regulators at one end of the structural element.

3. A flotation cell according to claim **1**, wherein the flow regulators of each structural element are identical in cross-section.

4. A flotation cell according to claim **1**, wherein at least two flow regulators of each structural element are different in cross-section.

5. A flotation cell according to claim **1**, wherein each flow regulator has an inner edge and an outer edge, the inner edge of the flow regulator is closer to the axis of rotation of the rotor than the outer edge, each structural element includes one flow regulator of which the inner edge is closer to said axis of rotation than the inner edge of another flow regulator of that structural element, and the structural elements are positioned around the rotor so that for each structural element the inner edge that is nearest the axis of rotation is at substantially the same distance from said axis of rotation as the inner edge of the flow regulator of another structural element.

6. A flotation cell according to claim **1**, wherein the stator is composed of structural elements installed on two different levels around the rotor.

7. A flotation cell according to claim **1**, wherein the structural elements are positioned around the rotor so that a tangential slurry jet emitted from the rotor is directed towards at least one flow regulator in order to prevent the slurry jet from flowing directly through the stator.

* * * * *

美卓奥图泰专利二：一种浮选设备用的辅助搅拌器

发明者：Peter Gerard Bourke
代理人：奥图泰公司
专利编号：US 7,886,912 B2
专利时间：2011 年 2 月 15 日

摘要：

该项专利发明提供了一个搅拌器用于浮选槽里的矿浆中。该搅拌器安置于中心驱动轴的一端，并轴向延申至槽体中，受上部的驱动装置的电机和减速机所驱动。浮选槽驱动轴的另一端包括驱动法兰相通过联轴器与电机相连接。同时，一个定子与安装在转子的四周，在浮选槽驱动轴上部四周有推泡锥，推泡锥的直径较小的一段朝向浮选槽的底部。浮选辅助搅拌器安装连接在浮选驱动轴上，位于推泡锥与转子顶部之间的驱动轴的中部，该辅助搅拌器带有径向的搅拌叶片，叶片与驱动轴轴向成 45 度的一个连接。

US007886912B2

(12) **United States Patent**
Bourke

(10) **Patent No.: US 7,886,912 B2**
(45) **Date of Patent: Feb. 15, 2011**

(54) **AUXILIARY AGITATOR FOR A FLOTATION DEVICE**

(75) Inventor: **Peter Gerard Bourke**, Western Australia (AU)

(73) Assignee: **Outotec Oyj**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1329 days.

(21) Appl. No.: **10/549,725**

(22) PCT Filed: **Mar. 16, 2004**

(86) PCT No.: **PCT/AU2004/000315**

§ 371 (c)(1),
(2), (4) Date: **Sep. 16, 2005**

(87) PCT Pub. No.: **WO2004/082841**

PCT Pub. Date: **Sep. 30, 2004**

(65) **Prior Publication Data**

US 2006/0249432 A1 Nov. 9, 2006

(30) **Foreign Application Priority Data**

Mar. 17, 2003 (AU) 2003901207

(51) **Int. Cl.**
B03D 1/16 (2006.01)
B03D 1/22 (2006.01)

(52) **U.S. Cl.** **209/169**; 261/87

(58) **Field of Classification Search** 209/169; 261/87

See application file for complete search history.

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(Continued)

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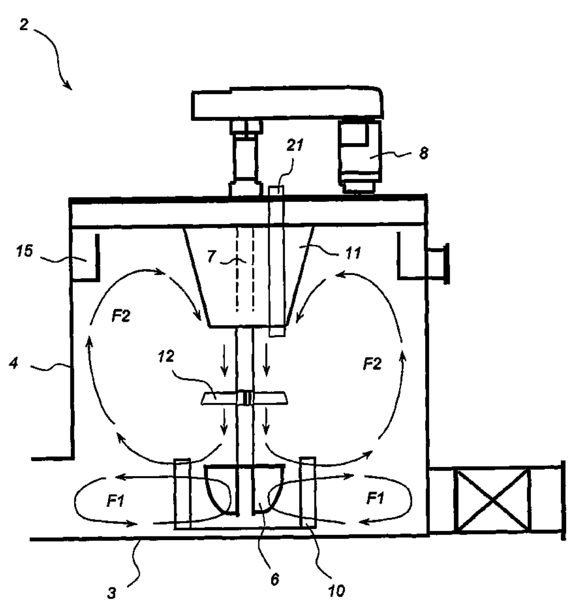
(Continued)

Primary Examiner—Thomas M Lithgow
(74) *Attorney, Agent, or Firm*—Fish & Richardson P.C.

(57) **ABSTRACT**

The invention provides an agitator (**1**) is disposed to agitate slurry within a flotation tank (**2**). The agitator includes a rotor (**6**) mounted on one end of a centrally disposed drive shaft (**7**) extending axially downwardly into the tank and driven by a motor (**8**) and associated gearbox (not shown). The other end of the drive shaft includes a mounting flange (**9**) adapted for connection to the motor. A stator (**10**) is also provided around the rotor. A froth deflection cone (**11**) extends around the drive shaft adjacent the top of the tank. The deflection cone is oriented such that its smallest diameter is located at its lowermost end nearest the rotor (**6**). An auxiliary agitator (**12**) is connected to the drive shaft at a position substantially midway between the underside of the deflection cone (**11**) and the top of the rotor (**6**), as shown in FIG. **1** and FIG. **2**. The auxiliary agitator (**12**) includes agitation blades (**13**) extending radially outwardly from diametrically opposite sides of the shaft (**7**). Each blade (**13**) intersects the shaft at an angle of incidence of around 45 degrees to the shaft axis (**14**).

35 Claims, 3 Drawing Sheets



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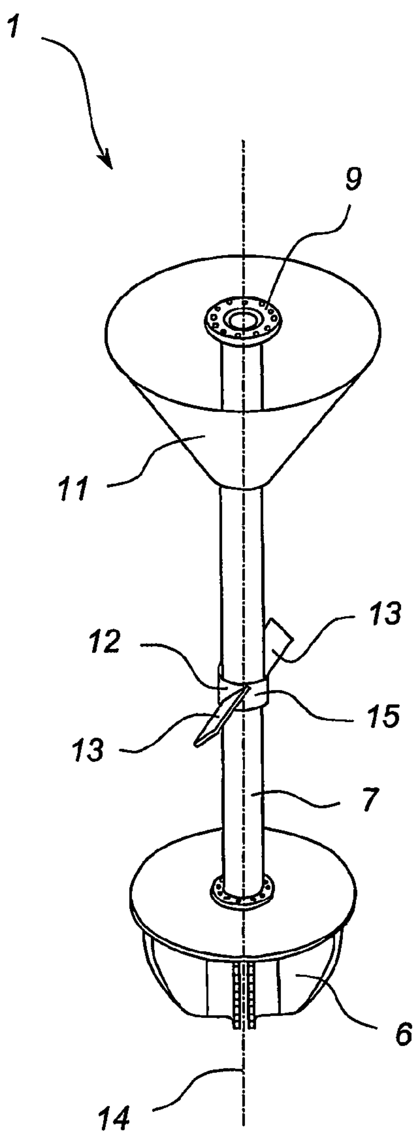

Figure 1

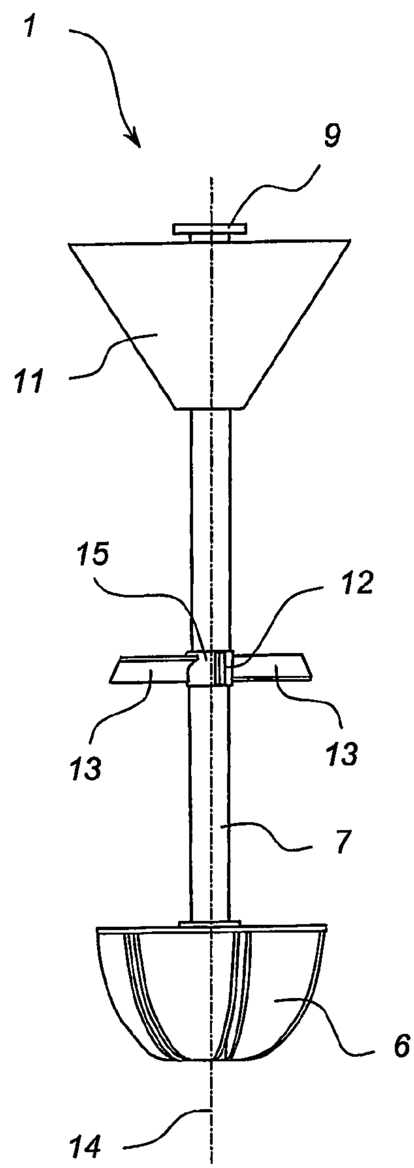

Figure 2

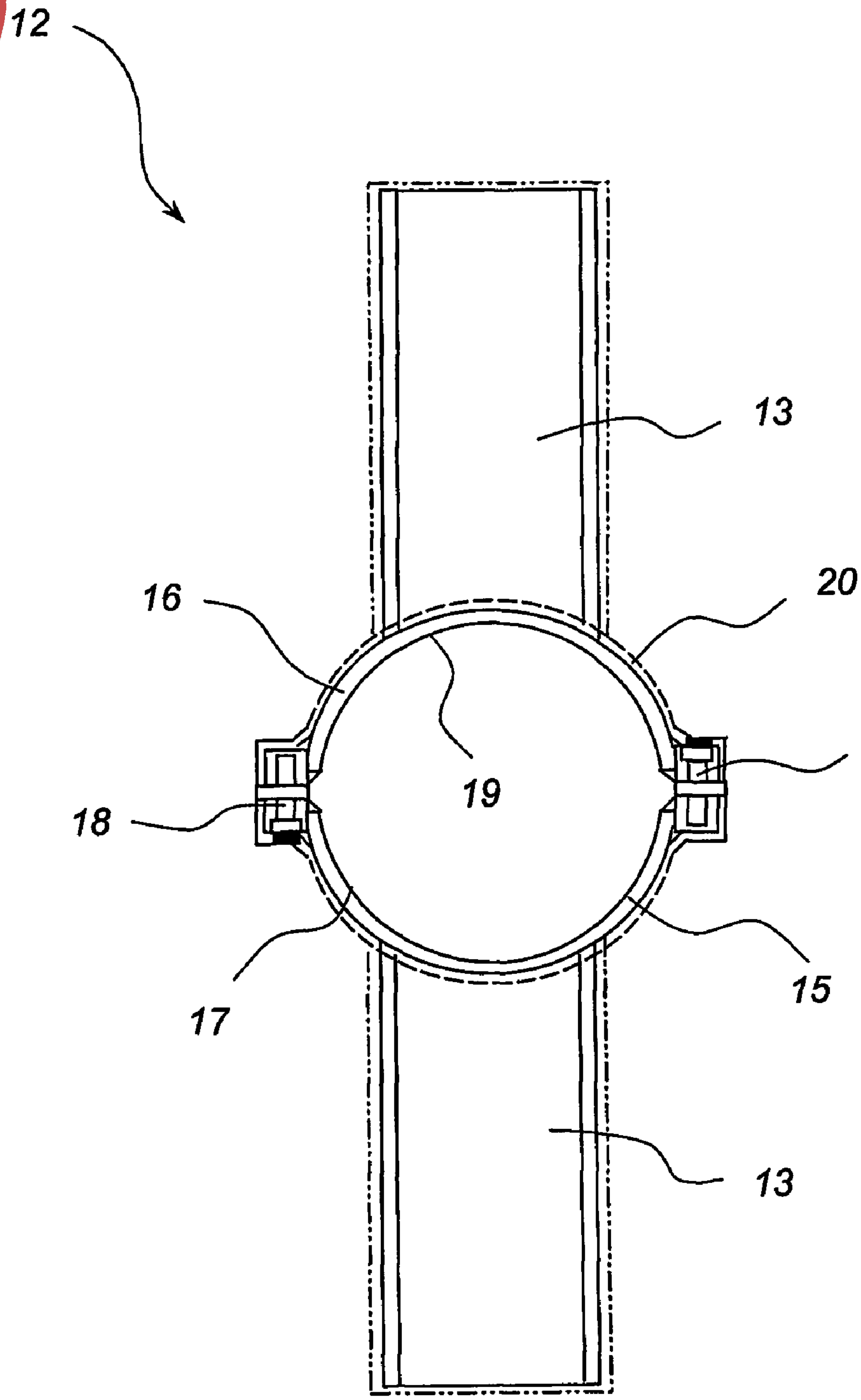

Figure 3

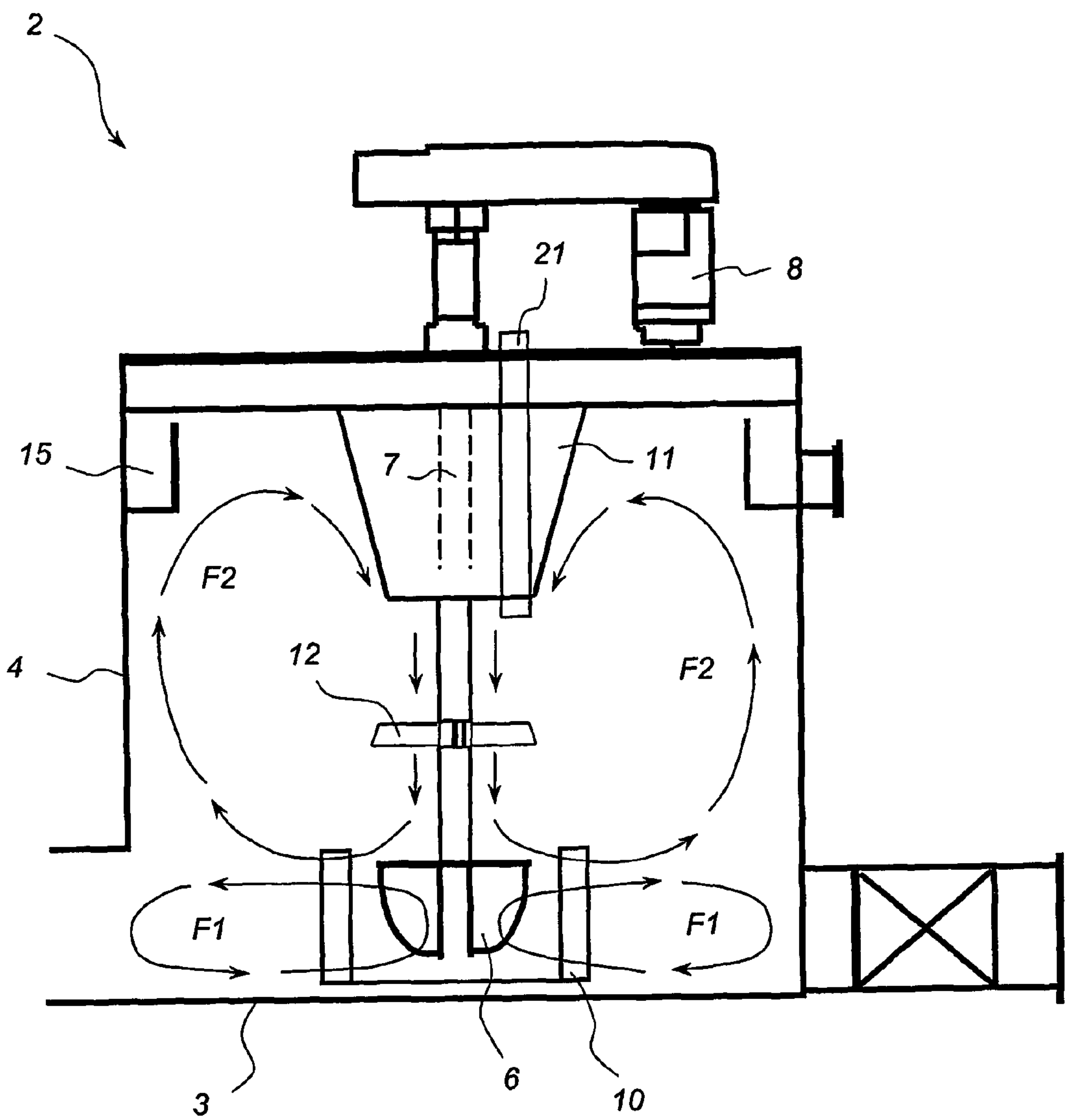

Figure 4

AUXILIARY AGITATOR FOR A FLOTATION DEVICE

This application is the national phase application under 35 U.S.C. §371 of International Application No. PCT/AU2004/000315 filed on Mar. 16, 2004, entitled, "AUXILIARY AGITATOR FOR A FLOTATION DEVICE" which claims the benefit of Australian Patent Application No. 2003901207 filed on Mar. 17, 2003.

FIELD OF THE INVENTION

The present invention relates to flotation devices of the type used in mineral separation and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

BACKGROUND OF THE INVENTION

The following discussion of the prior art is provided to enable the invention to be placed in an appropriate technical context, and to facilitate an appreciation of the advantages that flow from it. However, references to prior art should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

Conventional flotation devices typically include a tank to receive and contain slurry from a grinding mill, a cyclone separator, or the like. An agitator, comprising a rotor housed within a stator, is normally disposed within the tank to agitate the slurry. An aeration system is also provided to direct air under pressure into the agitator through a central conduit formed within the drive shaft. Suitable reagents are also added, which coat the surfaces of the mineral particles within the slurry to make the particles hydrophobic so as to preferentially promote bubble to particle attachment. As bubbles dispersed by the rotor rise toward the surface of the tank, they carry with them floatable valuable mineral particles, which form a mineral enriched surface froth. The froth then migrates over a lip and into a launder whereby the valuable mineral particles suspended in the froth are recovered from the tank as a mineral concentrate. The gangue particles remaining suspended in the slurry, along with those mineral particles not removed by flotation, are discharged from the tank through a bottom outlet. The bottom outlet often incorporates a dart or pinch valve, which is opened to allow the remaining slurry to progress under gravity feed to downstream treatment processes. An automatic control system, typically incorporating a liquid level sensor and a PID controller, regulates a control valve to maintain a substantially constant liquid level in the tank. The rotor disclosed in U.S. Pat. No. 4,078,026 is an example of a rotor that is used in prior art devices in this field.

As flotation devices increase in size, the agitation input energy must increase proportionally. Moreover, for a large flotation device to maintain efficiency, it must be capable of achieving a similar flotation kinetic rate as that achieved by a group of smaller cells of the same total volume.

In recent years, the size of flotation devices has increased, primarily for economic reasons. However, the design of such devices has remained relatively unchanged. Accordingly, for the reasons mentioned above, these large flotation devices are often not optimised in terms of flotation efficiency.

It is therefore an object of the present invention to overcome or substantially ameliorate one or more of the disadvantages of the prior art, or at least to provide a useful alternative.

SUMMARY OF THE INVENTION

Accordingly, a first aspect of the invention provides an auxiliary agitator for a flotation device of the type having a tank, a primary agitator including a primary rotor, drive means, and a drive shaft disposed intermediate the drive means and the primary rotor, the auxiliary agitator including:

an auxiliary agitation blade adapted, in use, to supplement an axial flow induced in the tank by the primary rotor; and

connecting means for connecting the blade to the drive shaft intermediate the drive means and the primary rotor.

Preferably, the angle of incidence is constant along the length of the blade, as in an axial impeller, at between 15 degrees and around 75 degrees with respect to the direction of travel of the blade. Alternatively, the angle of incidence varies along the length of the blade, as in a propeller. In another embodiment, the pitch of the blade is adjustable depending on specific system parameters, such as slurry density, slurry viscosity or flow characteristics within the tank.

Preferably, the blade includes a substantially straight leading edge. However, in alternative embodiments, the leading edge may be curved.

Preferably, the blade is releasably connected to the shaft to allow its position along the shaft to be adjusted. However, the blade is preferably connected to the shaft at around the mid-height of the tank.

Preferably, the connecting means include a clamp. More preferably, the clamp is formed of two inter-engageable clamping halves. More preferably, the two clamping halves are substantially identical. Even more preferably, inner walls of the clamp together define a generally cylindrical clamping surface. Alternatively, the connecting means take the form of welds or bolts.

Preferably, the agitator includes a resilient protective layer coating its exterior surfaces. More preferably, the layer is greater than 3 mm thick. Even more preferably, the layer is between around 5 mm and around 7 mm thick.

Preferably, the agitator includes a pair of the auxiliary blades, in use extending radially outwardly from diametrically opposite sides of the shaft, each blade having associated connecting means. Alternatively, the agitator includes at least three of the blades, in use equally spaced around the perimeter of the shaft, each blade having associated connecting means.

Preferably, in use, each blade intersects the shaft at an angle of incidence of around 45 degrees.

According to a second aspect, the invention provides agitation means for a flotation device of the type previously defined, said agitation means including:

a drive shaft;

a primary rotor connected to one end of the drive shaft to form the primary agitator; and

an auxiliary agitator as defined above.

Preferably, the agitation blade is releasably connected to the shaft to allow its position along the shaft to be adjusted. However, the blade is preferably located substantially at the midpoint of the drive shaft.

Preferably, the agitation means are suitable for use in a three phase environment including water, solids and air.

According to a third aspect, the invention provides a flotation device including:

a tank for containing slurry incorporating minerals to be extracted,

a feed inlet for admission of slurry into the tank;

agitation means, as defined above, to agitate the slurry within the tank; and

aeration means to aerate the slurry whereby floatable minerals in suspension form a surface froth.

Preferably, a stator surrounds the rotor.

Preferably, a peripheral overflow launder extends around the inside top of the tank for recovering mineral enriched froth from the surface.

Preferably, the aeration means include an air blower and a fluid conduit for directing air from the blower into the rotor. More preferably, the conduit includes an axial bore extending through the drive shaft. Alternatively, the conduit is disposed to direct air into the rotor from underneath.

Preferably, the flotation device includes a froth deflection cone extending around the drive shaft adjacent the top of the tank, the smallest diameter of the cone being at its lowermost end nearest the rotor. More preferably, the deflection cone is disposed to deflect froth outwardly toward the overflow launder as it migrates toward the surface of the tank. Even more preferably, the deflection cone is disposed to prevent vortexing at the tank surface.

Preferably, the auxiliary agitator is adapted for use in a flotation device having a tank with a capacity of at least 50 m^3.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view of an agitator incorporating agitation means according to the invention;

FIG. **2** is a side view of the agitator of FIG. **1**;

FIG. **3** is a top view of an auxiliary agitator according to the invention; and

FIG. **4** is a sectional side view of a typical flotation device incorporating the agitator.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawings, there is shown an agitator **1** for a flotation tank **2**, which tank contains a slurry incorporating minerals to be extracted. The illustrated tank includes a generally flat base **3** and a substantially cylindrical sidewall **4** extending upwardly from the base. However, it will be appreciated that in alternative embodiments, tanks of other shapes and sizes are used. A peripheral overflow launder **5** extends around the inside top of the sidewall for removing mineral enriched froth as it floats to the surface.

The agitator **1** is disposed to agitate the slurry within the tank. The agitator includes a rotor **6** mounted on one end of a centrally disposed drive shaft **7** extending axially downwardly into the tank and driven by a motor **8** and associated gearbox (not shown). The other end of the drive shaft includes a mounting flange **9** adapted for connection to the motor. A stator **10** is also provided around the rotor.

A froth deflection cone **11** extends around the drive shaft adjacent the top of the tank. The deflection cone is oriented such that its smallest diameter is located at its lowermost end nearest the rotor **6**.

An auxiliary agitator **12** is connected to the drive shaft at a position substantially midway between the underside of the deflection cone **11** and the top of the rotor **6**, as shown in FIG. **1** and FIG. **2**. The auxiliary agitator **12** includes agitation blades **13** extending radially outwardly from diametrically opposite sides of the shaft **7**. Each blade **13** intersects the shaft at an angle of incidence of around 45 degrees to the shaft axis **14**.

The blades **13** are connected to the shaft **7** by a clamp **15**. The clamp is formed from two clamping halves **16** and **17** secured together by bolts **18** and each including one blade **13**. The inner walls of the clamp define a cylindrical clamping surface **19**.

A 6 mm rubber coating **20** is provided on the outer surfaces of the auxiliary agitator to protect it from chemical and mechanical abrasion.

In use, the agitation blades **13** define an axial impeller to supplement an axial flow induced in the tank by the primary rotor **6**. The diameter of the impeller is around 15% to 35% of the diameter of the flotation tank.

An aeration system including an air blower and a fluid conduit (not shown) is also provided to direct air from the blower into the rotor **6**. The conduit is defined in part by an axial bore (not shown) extending through the rotor drive shaft **7**.

In use, the rotor **6** induces a primary flow through the slurry as indicated by arrows F**1**. The primary flow continuously recirculates the slurry at the bottom of the tank to maintain the particles in suspension. The aeration system continuously disperses air into the rotor to form fine bubbles, which collide with and adhere to the valuable mineral particles in the slurry and subsequently float to the top of the tank to form a mineral enriched surface froth. As the froth floats toward the surface, it is directed radially outwardly by the deflection cone **11** for recovery through the overflow launder **5**.

The primary rotor **6** also induces a secondary flow through the slurry as indicated by arrows F**2**. However, as flotation devices increase in size, the secondary flow induced by the primary rotor reduces. Accordingly, it has been found that when floatable particles drop out of the froth zone at the tank surface, the secondary flow induced by the primary rotor alone is often not sufficient to draw these particles back into the mixing zone of primary rotor for refloating, thereby reducing the cell efficiency. This problem is particularly relevant in flotation devices of capacity greater than around 150 m^3 to 200 m^3 or larger.

The auxiliary agitator **12** increases the secondary flow, F**2**, in large flotation devices to an extent comparable to that of a group of smaller cells of equivalent total volume. It achieves this by inducing a downward current, which increases the secondary flow turnover rate. This, in turn, draws floatable particles that have dropped out of the froth zone down through the tank and into the mixing zone of the primary rotor, thereby increasing the probability that these particles will be refloated, and hence increasing the overall efficiency of the recovery process. In addition, the auxiliary rotor also facilitates dispersion of reagents added to the slurry through a reagent addition tube **21** extending downwardly through the deflection cone **11**. This effect occurs primarily because of the increased downward pumping action induced by the auxiliary agitator, which forces the reagent enriched pulp downwards into the primary rotor for reflotation. It will be appreciated that the invention thereby provides both practical and commercially significant advantages over the prior art.

It will be appreciated that in other embodiments many components of the flotation device described above may be substituted with suitable alternatives. For example, the auxiliary agitator can be connected to the drive shaft by other means, such as welds or bolts. Also, the coating provided on the outer surfaces of the auxiliary agitator may be formed from an alternative material such as polyethylene and may also be of a different thickness. In one embodiment, the auxiliary agitator includes a curved leading edge, similar to that on a propeller. The auxiliary agitator can also be shaped to have a variable angle of incidence along its length. Moreover, while the invention has been described with reference to conventional flotation cells, it will be appreciated that the same principles may be applied to other flotation cells, such as flash flotation cells, or Skim Air cells.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

The invention claimed is:

1. A flotation device comprising:

a tank for containing slurry incorporating minerals to be extracted;

a feed inlet for admission of slurry into the tank;

an agitator to agitate the slurry within the tank comprising a drive mechanism, a primary rotor connected to the drive mechanism by a drive shaft, and an auxiliary agitation blade, the primary rotor being adapted to induce a primary fluid flow and a secondary fluid flow above the primary fluid flow within the tank, and the auxiliary agitation blade being disposed for coaxial rotation above the primary rotor to induce axial fluid flow in a downward direction, thereby to supplement the secondary flow induced by the primary rotor; and

an aerator comprising an air blower and a fluid conduit for directing air from the blower into the primary rotor so as to aerate the slurry whereby floatable minerals in suspension form a surface froth in the tank.

2. The flotation device according to claim **1**, wherein said auxiliary agitation blade induces substantially only axial flow in a downward direction.

3. The flotation device according to claim **2**, wherein the auxiliary agitation blade, in use, acts as an axial impeller to supplement an axial secondary fluid flow of the primary rotor.

4. The flotation device according to claim **2**, wherein the auxiliary agitation blade is part of an axial impeller.

5. The flotation device according to claim **1**, wherein the auxiliary agitation blade defines an angle of incidence that is substantially constant along the length of the blade.

6. The flotation device according to claim **5**, wherein the angle of incidence is between 15 degrees and around 75 degrees with respect to the direction of travel of the auxiliary agitation blade.

7. The flotation device according to claim **1**, wherein the auxiliary agitation blade defines an angle of incidence that varies along the length of the blade.

8. The flotation device according to claim **1**, wherein the pitch of the auxiliary agitation blade is adjustable depending on specific system parameters.

9. The flotation device according to claim **8**, wherein the specific system parameters include slurry density, slurry viscosity and flow characteristics within the tank.

10. The flotation device according to claim **1**, wherein the auxiliary agitation blade comprises a substantially straight leading edge.

11. The flotation device according to claim **1**, wherein the leading edge of the auxiliary agitation blade is curved.

12. The flotation device according to claim **1**, wherein the auxiliary agitation blade is releasably connected to the drive shaft to allow its position relative to the primary rotor to be adjusted.

13. The flotation device according to claim **1**, wherein, in use, the auxiliary agitation blade is connected to the shaft at around a midheight of the tank.

14. The flotation device according to claim **1**, wherein the auxiliary agitation blade is connected to the drive shaft for conjoined rotation with the primary rotor.

15. The flotation device according to claim **1**, wherein the auxiliary agitation blade is connected to the drive shaft by at least one of a clamp, welds and bolts.

16. The flotation device according to claim **15**, wherein the clamp is formed of two inter-engageable clamping halves.

17. The flotation device according to claim **15**, wherein inner walls of the clamp together define a generally cylindrical clamping surface.

18. The flotation device according to claim **1**, wherein the auxiliary agitation blade comprises a resilient protective layer coating its exterior surfaces.

19. The flotation device according to claim **18**, wherein the protective layer is greater than around 3 mm thick.

20. The flotation device according to claim **18**, wherein the protective layer is between around 5 mm and around 7 mm thick.

21. The flotation device according to claim **1**, comprising a pair of said auxiliary agitation blades, which in use extend radially outwardly from diametrically opposite sides of the drive shaft.

22. The flotation device according to claim **1**, comprising at least three of said auxiliary agitation blades, which in use are equally spaced around the perimeter of the drive shaft.

23. The flotation device according to claim **21** or **22**, wherein, in use, each auxiliary agitation blade intersects the shaft at an angle of incidence of around 45 degrees.

24. The flotation device according to claim **1**, wherein the fluid conduit comprises an axial bore extending through the drive shaft.

25. The flotation device according to claim **1**, wherein the fluid conduit is disposed to direct air into the rotor from underneath.

26. The flotation device according to claim **1**, comprising a stator surrounding the rotor.

27. The flotation device according to claim **1**, wherein the agitator is adapted for use in a three phase environment comprising water, solids and air.

28. The flotation device according to claim **1**, comprising a froth deflection cone extending around the drive shaft adjacent the top of the tank, the smallest diameter of the cone being at its lowermost end nearest the rotor.

29. The flotation device according to claim **28**, comprising a peripheral overflow launder extending around the inside top of the tank and wherein the deflection cone is disposed to deflect froth outwardly toward the overflow launder for recovering mineral enriched froth from the surface of the tank.

30. The flotation device according to claim **28**, wherein the deflection cone is disposed to prevent vortexing at the tank surface.

31. The flotation device according to claim **28**, wherein the auxiliary agitation blade is located substantially midway between the top of the rotor and the bottom of the deflection cone.

32. The flotation device according to claim **28**, comprising a reagent addition tube extending downwardly into the tank through the deflection cone.

33. The flotation device according to claim **1**, adapted for agitating a slurry containing up to around 55% solids.

34. The flotation device according to claim **1**, wherein the tank has a capacity of at least 50 m^3.

35. The flotation device according to claim **1**, wherein said auxiliary agitation blade has a diameter of around 15% to around 35% of the tank diameter.

* * * * *

美卓奥图泰专利三：一种浮选机转子

发明者：Timo Niitii
代理人：奥图泰公司
专利编号：US 7,980,842 B2
专利时间：2011 年 7 月 19 日

摘要：

该项专利发明涉及一种浮选机的转子装置，尤其针对于一种用于矿浆中的空气弥散的转子装置，该转子装置由空气流道、矿浆通道和一个与转子相匹配的引流矿浆的烟囱底组成，使得矿浆可以流入转子内部而避免出现不希望的切向流现象。该种专利的转子装置可以避免浮选机的沉砂现象，同时给矿浆提供最佳的空气弥撒效果。

US007980824B2

(12) **United States Patent**
Niitti

(10) **Patent No.: US 7,980,824 B2**
(45) **Date of Patent: Jul. 19, 2011**

(54) **ROTOR FOR A FLOTATION MACHINE**

(75) Inventor: **Timo Niitti**, Kuopio (FI)

(73) Assignee: **Outotec Oyj**, Espoo (FI)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1118 days.

(21) Appl. No.: **11/576,327**

(22) PCT Filed: **Oct. 4, 2005**

(86) PCT No.: **PCT/FI2005/000422**

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(2), (4) Date: **Mar. 29, 2007**

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PCT Pub. Date: **Apr. 13, 2006**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
B03D 1/16 (2006.01)

(52) **U.S. Cl.** .... **416/185**; 416/231 A; 415/117; 261/91

(58) **Field of Classification Search** .... 415/58.6, 415/115, 116, 117, 121.1, 121.2; 416/90 R, 416/93 R, 181, 185, 195, 231 A, 231 B, 231 R; 261/91
See application file for complete search history.

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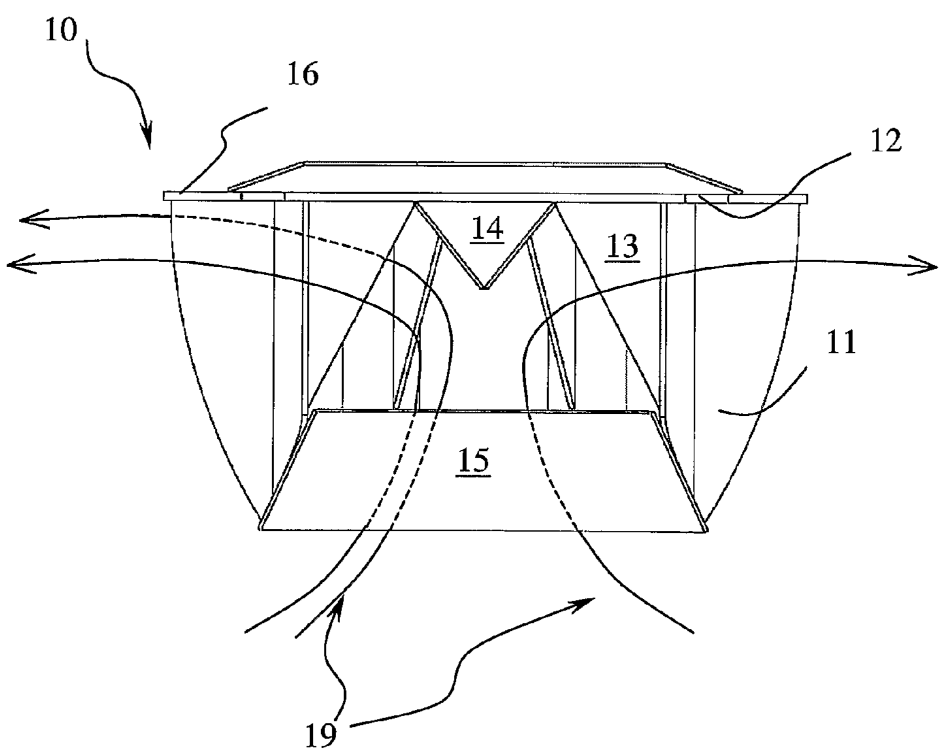
Primary Examiner — Nathaniel Wiehe
(74) *Attorney, Agent, or Firm* — Chernoff, Vilhauer, McClung & Stenzel

(57) **ABSTRACT**

The invention relates to a rotor of a flotation machine, particularly to a rotor, that is used for dispersing air to a slurry, and which rotor comprises alternating air ducts and slurry grooves and a collar fitted to the rotor for guiding the slurry flow into the interior of the rotor for avoiding undesired cross flow effect of the slurry flow. The rotor of the present invention efficiently prevents sanding effect and provides excellent dispersion of air into the slurry.

13 Claims, 3 Drawing Sheets



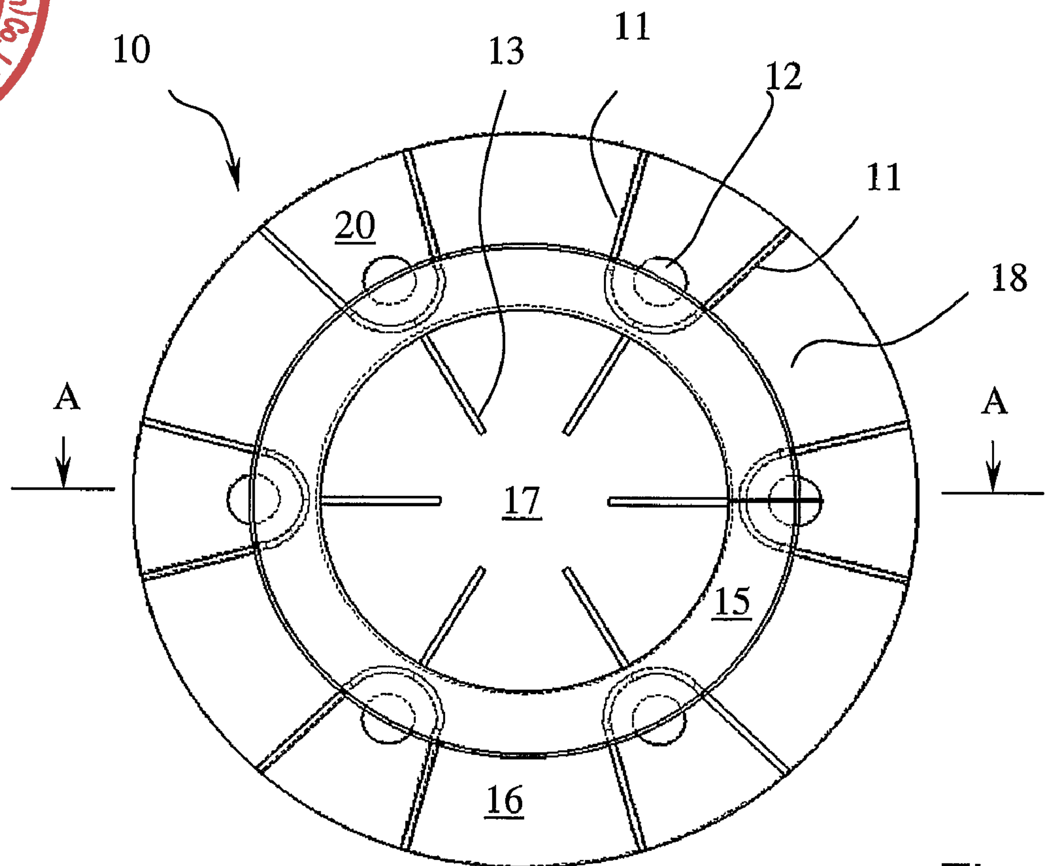


Fig. 1

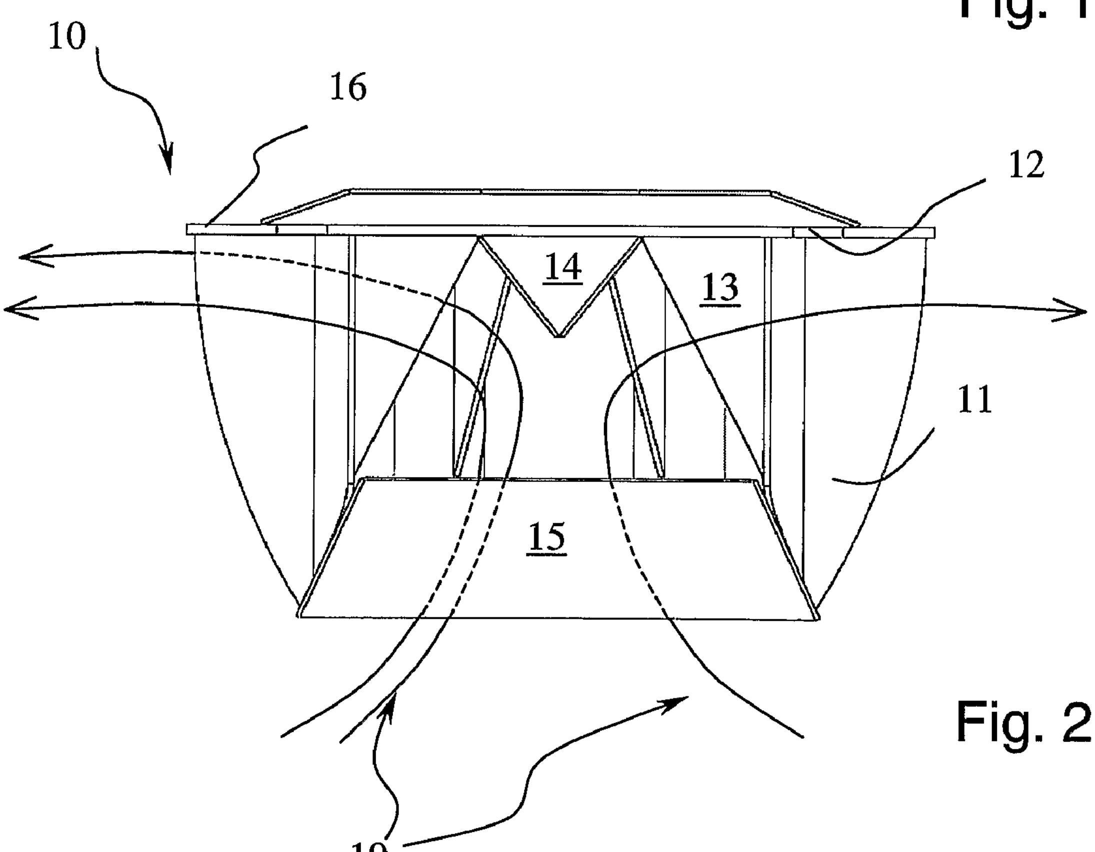


Fig. 2

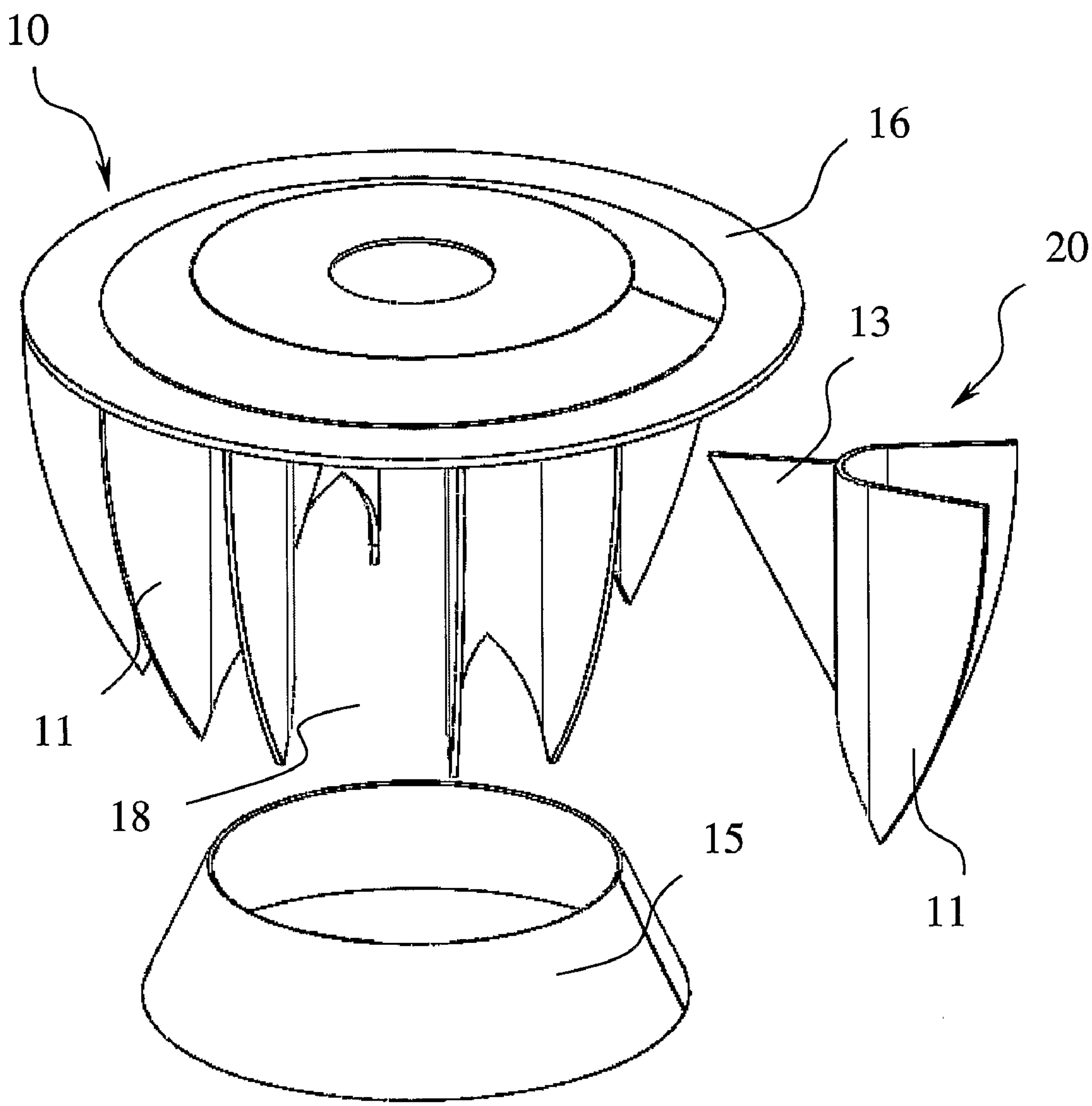


Fig. 3

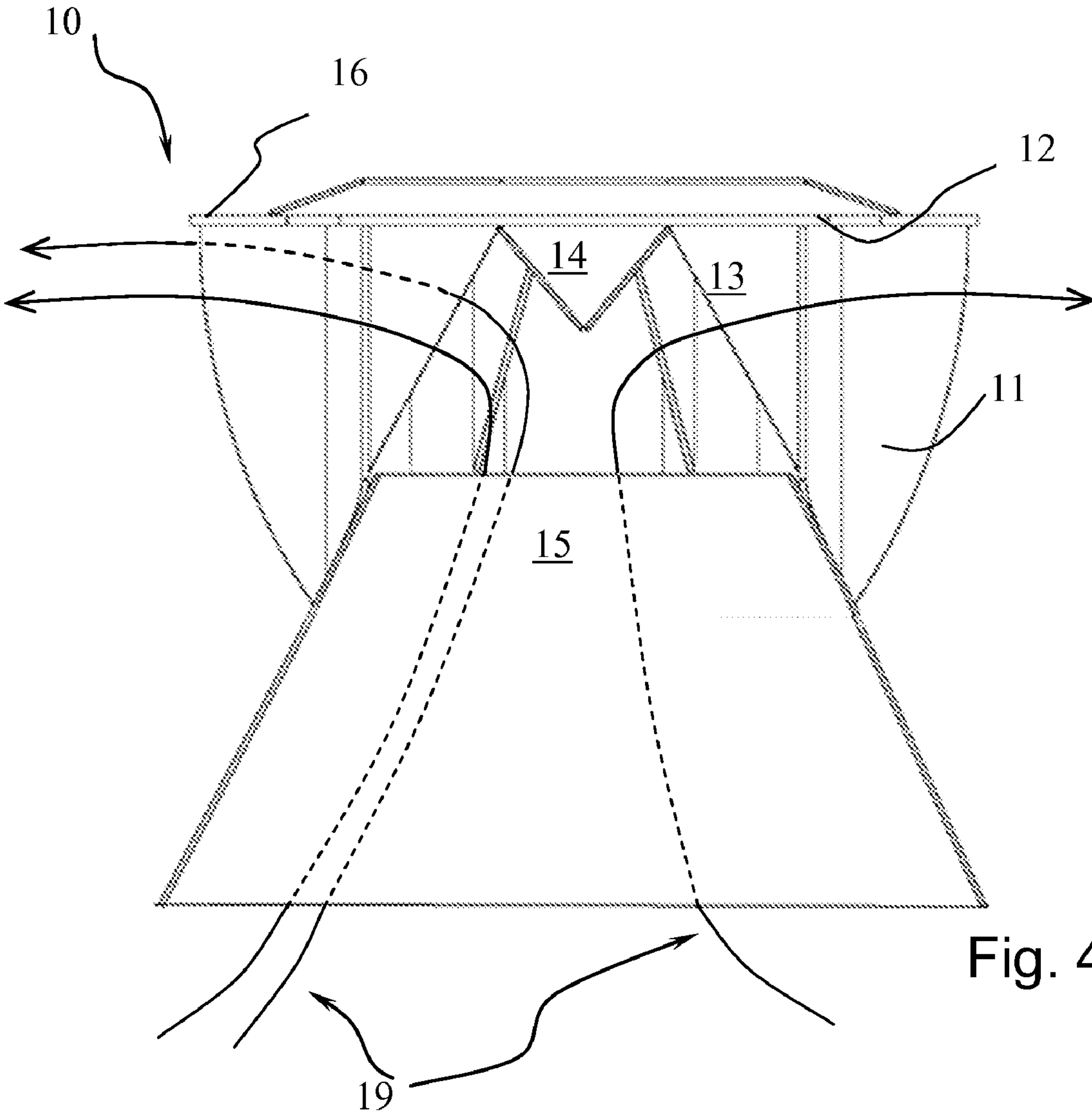


Fig. 4

ROTOR FOR A FLOTATION MACHINE

This is a national stage application filed under 35 USC 371 based on International Application No. PCT/FI2005/000422 filed Oct. 4, 2005, and claims priority under 35 USC 119 of Finnish Patent Application No. 20041297 filed Oct. 7, 2004.

The present invention relates to a flotation machine that is used for recovering valuable ingredients from slurry, such as slurry that contains minerals. In particular, the invention relates to a rotor of a flotation machine, which rotor is arranged to rotate for setting the slurry fed into the flotation cell in motion and is dispersing air into the slurry.

A flotation machine used for recovering valuable ingredients, such as metal concentrates, usually comprises a flotation cell provided with an inlet aperture for feeding slurry into the cell, and an outlet aperture for letting the non-flotated material, i.e. tailings, out of the cell. The air needed for creating the froth is fed to the rotor through a duct arranged to the shaft of the rotor. When rotating the rotor, air is fed into the slurry, and air bubbles are dispersed therein. Air bubbles flow upwards and enter the surface of the slurry where they form a froth bed. Reversed flotation is a process where valueless ingredients are made hydrophobic and the valuable material remains non-flotated and is removed as tailings from a flotation machine through a discharge opening arranged close to the bottom of the cell.

The dispersion mechanism of a flotation machine comprises a rotor and a stator. For example, U.S. Pat. No. 4,078,026 discloses a flotation cell with a rotating rotor and a stationary stator, which is arranged to encircle the rotor. The rotor fastened in a hollow vertical shaft rotates in the slurry and air is fed through the rotor into a clearance arranged between the rotor and the stator. The rotor comprises vertical blades defining alternating air ducts and slurry grooves.

WO 02/081093 discloses a rotor that comprises vertical air ducts and a cover disc whereto the air ducts are arranged. The air ducts are open at their lower ends and closed at their upper ends by the cover disc. The walls of the air ducts radially extend from the interior of the rotor to the periphery of the rotor and form vertical mixing and pumping blades of the rotor. The air ducts are arranged at essentially equal distances from one another. The air ducts define a space for the slurry in the interior of the rotor and the outer surface of the air duct walls define slurry grooves that alternate with the air ducts. The air duct walls are mutually divergent and diverge form each other in the direction proceeding outwardly from the center part of the rotor. The outer edges of the air duct walls define the periphery of the rotor. The cross sectional diameter of the rotor preferably decreases towards the lower end of the rotor. Air is conducted via air channels from the hollow shaft into the air ducts.

The present invention provides an improved rotor for a gas dispersion mechanism of a flotation machine. The rotor of the present invention is efficient in preventing sanding effect on the bottom of the flotation machine and provides efficient gas dispersion that makes the hydrophobic particles and dispersed bubbles to get into contact. An object of the present invention is to improve the performance of a prior art rotor disclosed in WO 02/081093. The rotor according to the present invention decreases cross-flow effect that has been observed in connection with the operation of the prior art rotor. Cross-flow effect means that aerated slurry returns into the dispersion mechanism immediately after having exited the mechanism. The essential novel features of the invention are enlisted in the appended claims.

The present invention is a rotor of a gas dispersion mechanism to be used in a flotation machine comprising a cover disc arranged to a rotatable shaft, air ducts that are arranged to protrude downwards from the cover disc defining a space for the slurry in the interior of the rotor. The air duct walls extend from the interior of the rotor to the periphery of the rotor thus forming mixing and pumping blades of the rotor. Slurry grooves are defined by the outer surfaces of the air duct walls, the slurry grooves being in fluid communication with the space for the slurry. Air channels are arranged for conducting air into the air ducts. A collar is arranged inside the rotor to encircle part of the slurry space and to guide the slurry flow into the interior of the rotor so as to prevent the cross-flow effect.

The collar is preferably arranged to the lower ends of the air ducts. The collar is fitted to the rotor so as to rotate along with the rotor. The collar, as being rigid and fitted to the air ducts, supports the air ducts and makes the rotor structure rigid.

Typically, the rotating shaft is hollow for providing an air channel for dispersion air to flow into the rotor. Often, the air ducts are essentially vertical and arranged at essentially equal distances from one another. According one embodiment of the invention the air ducts are open at their lower ends and closed at the upper ends by the cover disc.

According to one preferred embodiment of the present invention the number of the air ducts arranged to the cover disc and installed at equal distances from each other is six or higher and the height of the air ducts is 40-60% of the radius of the cover disc. The air duct walls are preferably mutually divergent, and they are advantageously directed towards the center of the rotor axis, so that the wall extensions intersect at the center point of the rotor. Thus the air duct walls preferably form an angle of 15-30 degrees. In addition, the design of the air ducts preferably ensures that the air duct discharge surface with respect to the slurry extends essentially uniformly from the cover disc to the bottom of the rotor. Therefore, air can be fed through the air ducts into the slurry essentially along the whole height of the rotor.

The slurry grooves and the internal slurry space defined by the air ducts and air duct walls of the rotor essentially fill the remaining rotor volume.

When rotating, the rotor of the present invention creates a pumping effect that makes the slurry flow into the internal space defined by the air ducts and the cover disc in the rotor. Majority of the slurry flow passes through a collar arranged to encircle the slurry space. The collar is preferably attached to the lower ends of the air duct walls and extends into the rotor interior and towards the cover disc a distance that preferably corresponds to one half to one sixth of the height of the air ducts. The collar may extend towards the cover even a longer distance than one half of the height of the air ducts. The total height of the collar is not limited to the height of the rotor or the air ducts, since the collar may extend outwards from the periphery of the rotor and towards the bottom of the flotation cell. The slurry exits the slurry space via slurry grooves between the air ducts.

According to the preferred embodiment of the present invention internal mixing and pumping blades are arranged to each air duct protruding towards the center of the rotor, i.e. towards the slurry space inside the rotor. According to another embodiment of the present invention an internal mixing and pumping blade is an essential part of the air duct and therefore represents an extension to an air duct.

According to the preferred embodiment of the present invention the cross section of the air ducts is U-shaped, wherein the branches of U forms the air duct wall and the mixing blades of the rotor.

According to another embodiment of the present invention the cross section of the air duct is angular. According to one more embodiment of the present invention the cross section of the air duct is V-shaped.

The invention is described in more detail below with reference the appended drawings, where

FIG. **1** is a schematic illustration of a preferred embodiment of the invention, seen from below,

FIG. **2** shows a cross sectional side view A-A of the embodiment of FIG. **1** ,

FIG. **3** shows a perspective exploded view of the preferred embodiment of FIG. **1** and FIG. **2**, and

FIG. **4** shows a cross sectional side view of a second embodiment.

The rotor of FIGS. **1-3** is arranged to a hollow shaft (not shown) via a cover disc **16**. Air ducts **20** are attached to the cover disc **16**. The walls defining the air ducts **20** extend along the cover disc, starting from the outer edge of the cover disc **16**, radially towards the center of the disc a distance that is 50% of the length of the radius of the cover disc **16**.

The air duct walls are mutually divergent and the extension lines of the walls intersect at the center point of the rotor. The air duct walls diverge from each other in an angle of 20 degrees.

Channels for conducting air from the hollow shaft to the air ducts are arranged inside the cover disc. Air flow enters the air ducts via apertures **12** arranged to the cover disc **16**. The aperture for the air to enter the air duct may be arranged at any point of the walls defining the air duct. According to another embodiment of the invention, air is introduced into the air duct through a channel arranged inside an air duct extension **13**.

The slurry grooves **18** defined by the outer surface of the air duct wall are in fluid communication with the slurry space **17** that is provided for the slurry in the center part of the rotor **10**.

The rotor creates a pumping effect and suction that draws the slurry into the rotor. The slurry flow enters the rotor via a collar **15** arranged to encircle part of the slurry space **17**. The collar **15** is attached to the air duct walls **11** at their lower end and the collar **15** extends from the bottom of the rotor **10** towards the cover disc **16** by a distance that is 25% of the height of the air ducts **20**. In the second embodiment, shown in FIG. **4**, the collar extends outward from the outer edges of the air duct walls and towards the bottom of the flotation cell.

A slurry flow guide **14** is arranged to the bottom of the cover disc **16** to enhance the slurry to exit the interior **17** of the rotor **10**. Arrows **19** indicate the direction of the main stream of the slurry flow.

Internal mixing and pumping blades **13** are arranged to extend from the air ducts towards the center of the rotor. In this embodiment the internal mixing and pumping blades are triangle plate elements spanning between the air duct walls **11**, the bottom of the cover disc and the slurry flow guide **14**.

EXAMPLE

The various benefits of this invention can be seen in the following test results, where the rotor of our invention was tested against a prior art rotor disclosed in U.S. Pat. No. 4,078,026 having the same diameter and rotation speed. Sanding effect and air hold-up performances were monitored. In this context sanding means the amount of solid particles lying on the bottom of the flotation cell, usually measured in thickness of the solids layer. The higher is the amount, the smaller is the effective volume of the cell. The inactive particles (both valuable and gangue) also have a tendency to form hard mud, which makes maintenance work difficult. The hardened material can detach in large chunks and cause failure in the flotation cell impellers and valves. Air hold-up is the total volume of air bubbles contained in the cell. Volume is defined by quantity and size. Usually, the volume is measured as percentage of the total cell volume. The higher the quantity is, the more opportunities there are for bubble-particle attachment. The smaller the bubbles, the higher is the volume due to weaker buoyancy force and thus slower rise velocity. Thus, the theoretical ultimate aim would be to disperse a maximum number of bubbles, which are just big enough to carry the mass of the particle.

Sanding was completely eliminated in conditions where standard rotor left 17% of the sand at the bottom of the tank.

The efficiency of air dispersion was improved. In water the standard rotor could create an air hold-up of 11.5% and this improved rotor could increase the air hold-up to 22% with the same air flow. The reason for increased air hold-up is that the air bubbles created by the improved rotor were smaller and thus remained a longer time in the cell.

In an industrial scale test at 40% solids by weight, the rotor of this invention was able to disperse 20 m^3/min of air against 14 m^3/min by a standard rotor.

The invention claimed is:

1. A rotor of a gas dispersion mechanism to be used in a flotation machine, the rotor comprising:

a cover disc for attachment to a rotatable shaft,

air ducts extending downward from the cover disc in an outer region of the rotor for delivering air to the periphery of the rotor whereby the rotor defines a space for the slurry inward of the air ducts, the air ducts being defined by air duct walls extending from the interior of the rotor to the periphery of the rotor and forming mixing and pumping blades of the rotor, wherein outer surfaces of the air ducts define slurry grooves that are in fluid communication with the space for the slurry,

air channels for conducting air into the air ducts, and

a collar disposed below the cover disc and encircling part of the slurry space for guiding the slurry flow into the interior of the rotor,

and wherein the collar has an upper edge and the air duct walls have lower end portions that extend downward beyond the upper edge of the collar and are disposed outward of the collar.

2. The rotor according to claim **1**, wherein the collar is attached to the lower end portions of the air duct walls.

3. The rotor according to claim **1**, wherein the collar has a lower edge forming a the bottom line of the rotor and the collar extends upward from the bottom line of the rotor a distance that is between one half to one sixth of the height of the air duct walls.

4. The rotor according to claim **1**, wherein the collar extends outwards and downwards from outer edges of the air duct walls.

5. The rotor according to claim **1**, wherein the shape of the collar is a truncated cone.

6. The rotor according to claim **1**, wherein the height of the air ducts is 40-60% of the length of the radius of the cover disc.

7. The rotor according to claim **1**, wherein the walls of the air ducts are mutually divergent and diverge from each other in an angle of 15-30 degrees.

8. The rotor according to claim **1**, wherein each air duct has two air duct walls that extend substantially radially of the rotor.

9. The rotor according to claim **8**, wherein the two air duct walls of each air duct diverge outwardly of the rotor at an angle in the range from 15 to 30 degrees.

10. The rotor according to claim **1**, wherein the cover disc is formed with channels for supplying air to the air ducts.

11. The rotor according to claim **1**, wherein the rotor comprises at least six air ducts.

12. The rotor according to claim **1**, further comprising internal mixing blades protruding from each air duct towards the center of the rotor.

13. The rotor according to claim **1**, wherein the cover disc comprises a bottom plate formed with apertures communicating with the air ducts and also comprises a top plate spaced from the bottom plate and formed with a central opening, whereby the space between the bottom plate and the top plate defines a channel for conducting air from the central opening in the top plate to the apertures in the bottom plate.

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