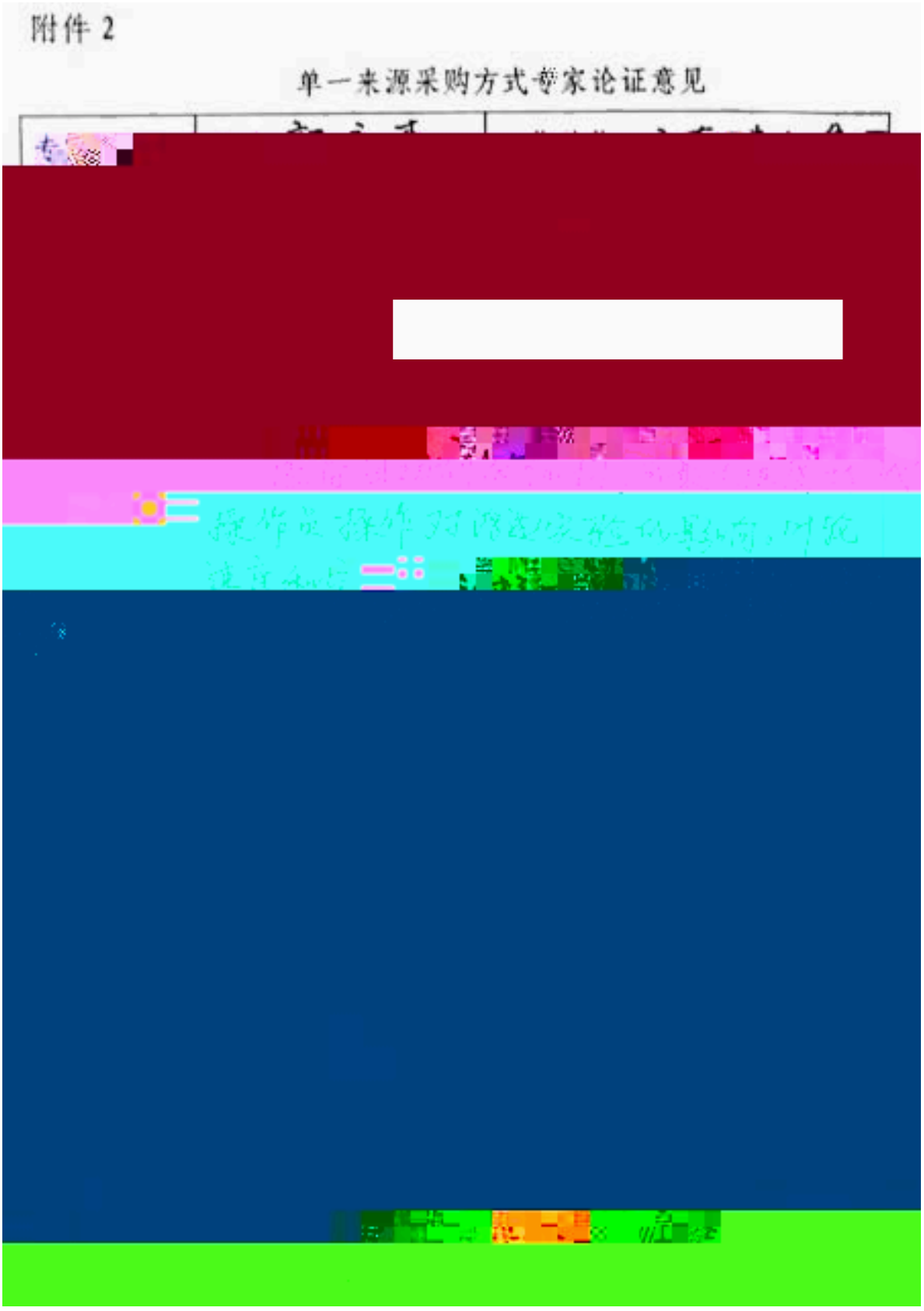
附件 2

单一来源采购方式专家论证意见



附件 2

单一来源采购方式专家论证意见

专家信息	姓名：方小金	工作单位：中国[illegible]
	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”	
	[illegible]	
	预次，完善实和教学建设。 [illegible]DCS研发中心项目设备HSC che-	
	[illegible]	

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：[illegible]	工作单位：[illegible]
	职称：工高级讲师	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：美卓奥	
专家论证意见	美卓奥谱系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结果的影响，[illegible]对提高实验效率有积极意义。 由于该机有专利保护，其它在售无此型号，同时该品牌也不属于进口，限制进口产品，参照招采管理[illegible]。	
专家签字	冉银华	签字日期　　年　月　日

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单一来源采购方式专家论证意见

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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	[illegible]（GTK Lab cell）浮选机[illegible]，有助于“双一流”平台建设[illegible]……生找到最佳操作条件，[illegible]……奥图泰公司长期以来浮选设备的设计和[illegible]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，[illegible]……无法替代，故同意采用单一来源方式[illegible]
专家组签字	[illegible]　郭永杰　万小金
签字日期	2023年3[illegible]

注：本表格中专家意见由专家手工填写。

Metso:Outotec

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2022年6月20日

美卓奥图泰国际贸易（天津）有限公司

US007458467B2

United States Patent

(12)

(10) Patent No.: US 7,458,467 B2

(45) Date of Patent: Dec. 2, 2008

Grönstrand et al.

(54) STATOR FOR A FLOTATION CELL

209/168

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(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**

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

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

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

Prior Publication Data

2007/0181468 A1 Aug. 9, 2007

Foreign Application Priority Data

2004 (FI) 20040498

Int. Cl.
B 1/16 (2006.01)

U.S. Cl. **209/169**; 209/168

See application file for complete search history.

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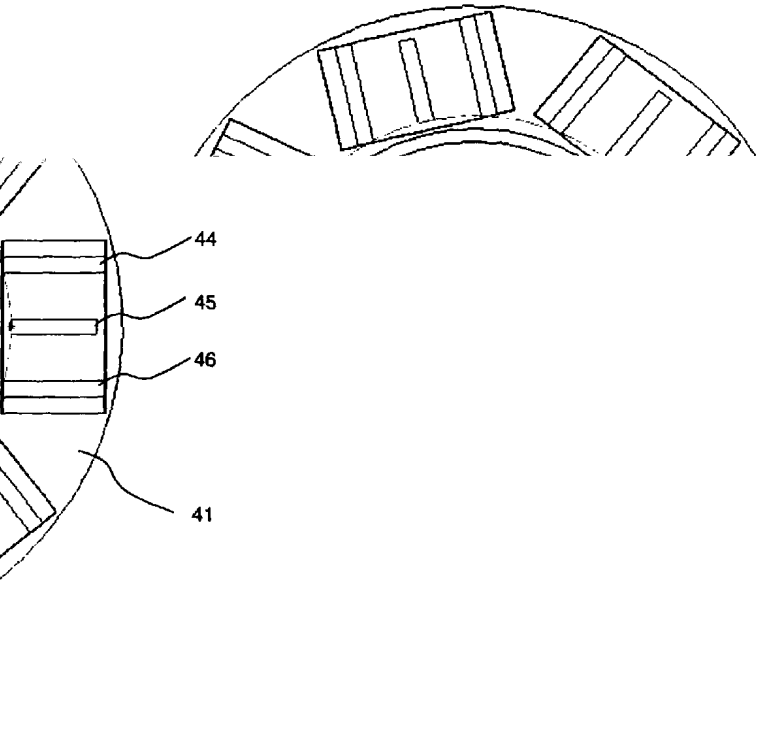
Primary Examiner—Thomas M Lithgow

(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



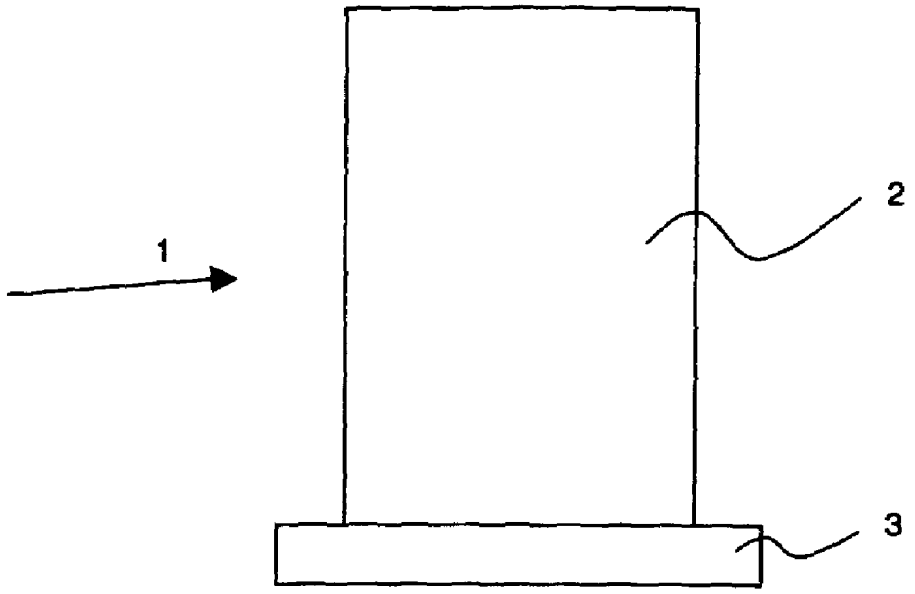


Fig. 1

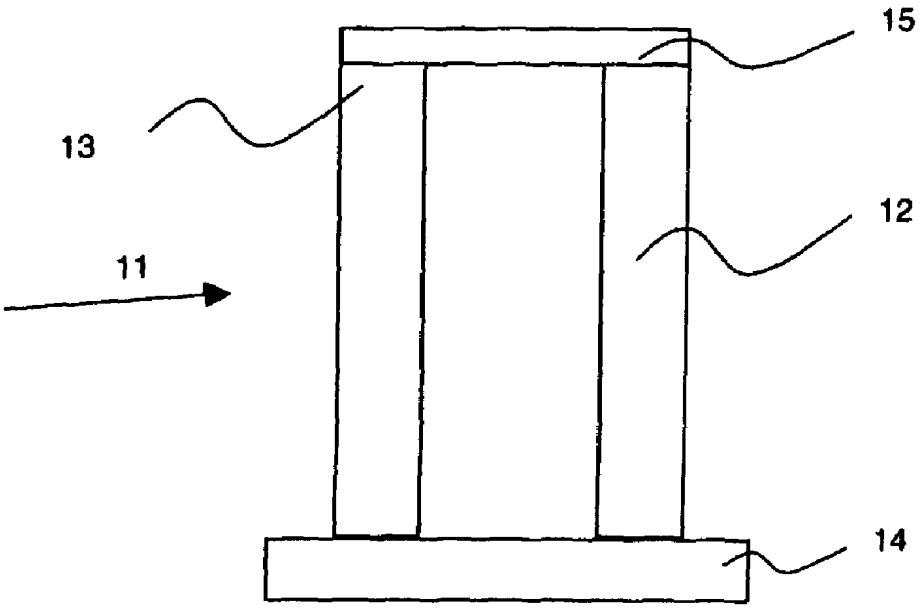


Fig. 2

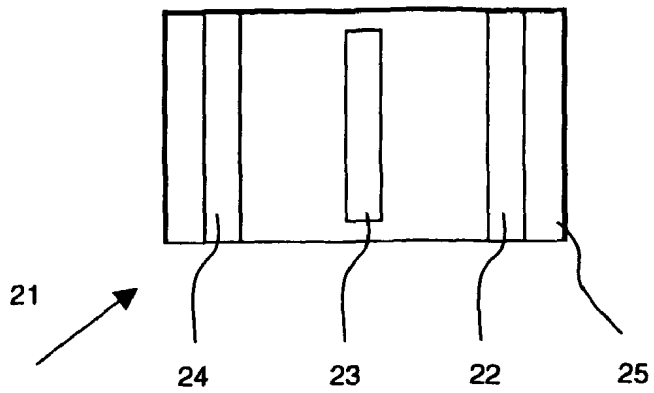


Fig. 3

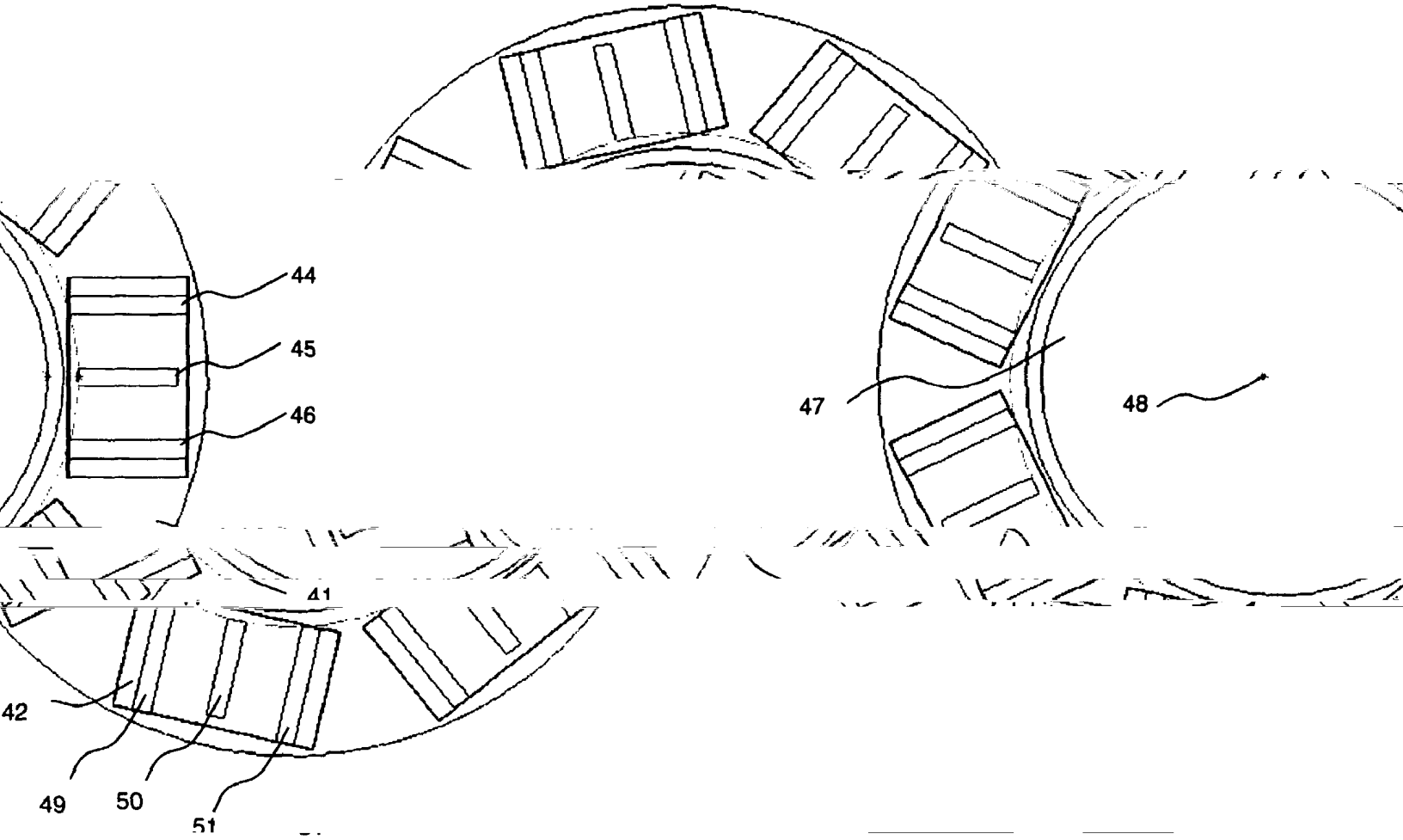


Fig. 4

STATOR FOR A FLOTATION CELL

directed preferably towards at least one flow regulator of the

ing 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

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aim **1**, wherein the flow
t are identical in cross-

m **1**, wherein at least two
ement are different in

1, wherein each flow
tor has an inner edge and an outer edge, the inner edge

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

form the structural element, and interconnecting the flow regulators, the supporting structure and the connecting element by welding.

structure **14** common to the flow regulators **12** and **13**, by

and **13** can be connected to the flotation cell or to a stator

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

ments 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 element,

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

and a structural element is manufactured by casting the flow regulators, the supporting stru the connecting element, assembling the flow r

includes two flow regulators **12** and **13**. At the flow regulators **12** and **13**

2. A flotation cell according to claim **1**, wherein the flow

the supporting structure, which is attached to the fl lators at one end of the structural element.

3. A flotation cell according t regulators of each structural ele section.

4. A flotation cell according to flow regulators of each structura cross-section.

5. A flotation cell according to

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

(12) **United States Pa**
Bourke

VICE

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ignee: **Outotec Oyj**, Espoo (FI)

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

l. No.: **10/549,725**

T Filed: **Mar. 16, 2004**

T No.: **PCT/AU2004/000315**

71 (c)(1),
(4) Date: **Sep. 16, 2005**

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

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

(65) **Prior Publication Data**

ent the top of the tank. The deflection cone is
t its smallest diameter is located at its lower-
t the rotor (**6**). An auxiliary agitator (**12**) is
connected to the drive shaft at a position substantially mid-
way 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**) extend-
ing 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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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 treatment 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

(30) **Foreign Application Priority Data**

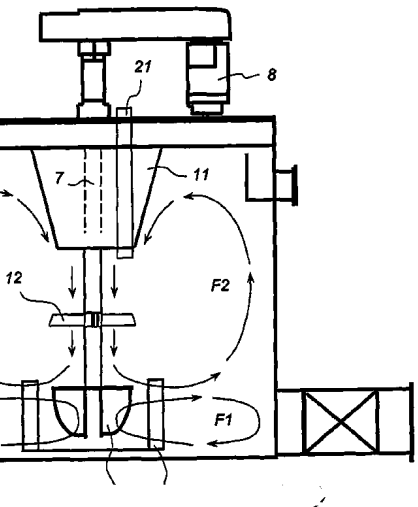
Mar. 17, 2003 (AU) 2003901207

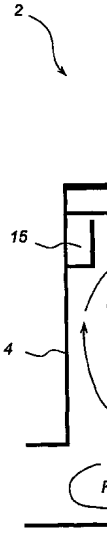
(51) **Int. Cl.**
B03D 1/16 (2006.01)
B03D 1/22 (2006.01)

(52) **U.S. Cl.** .....

(58) **Field of Classification Search** .....

See application file for complete sear





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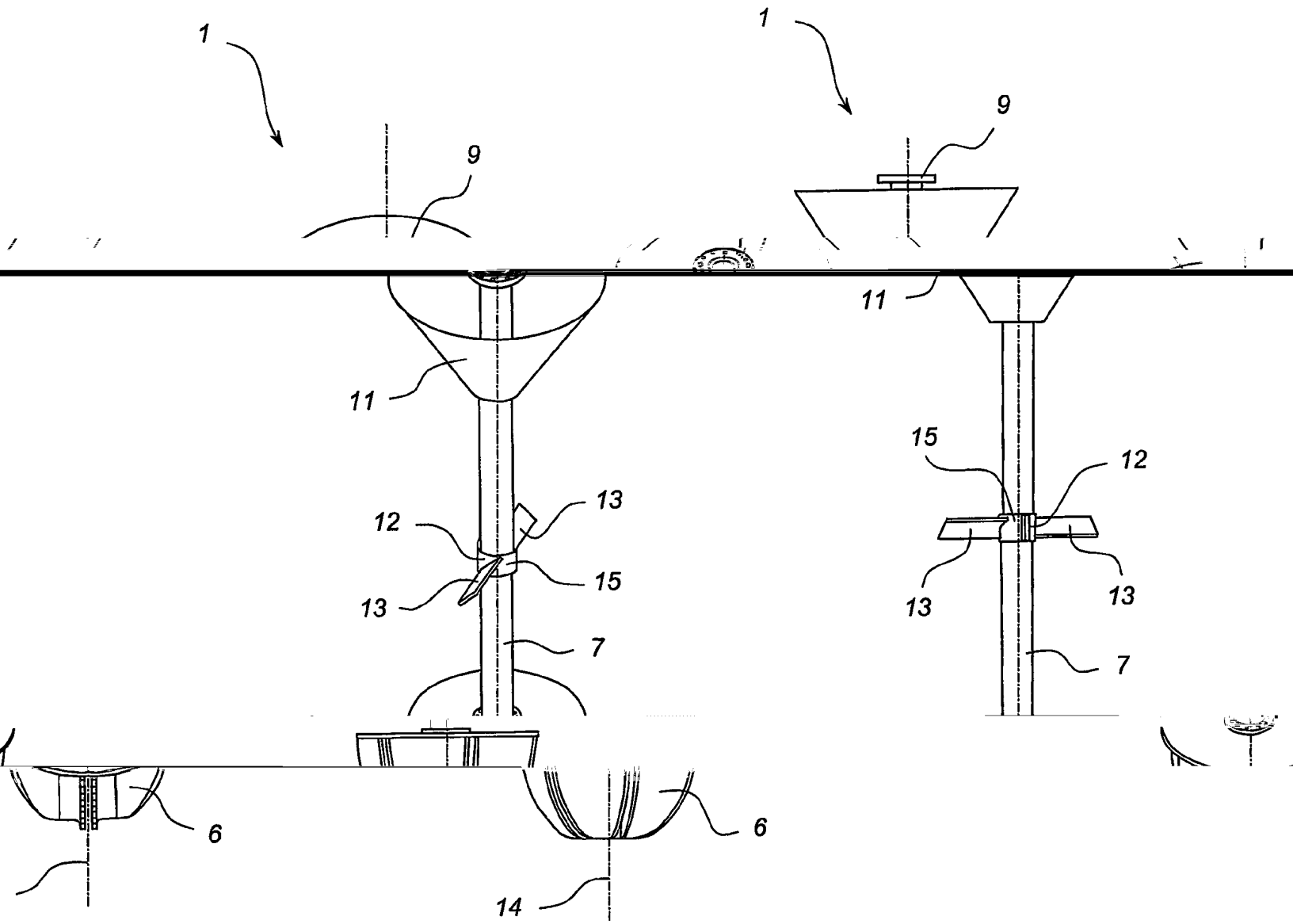
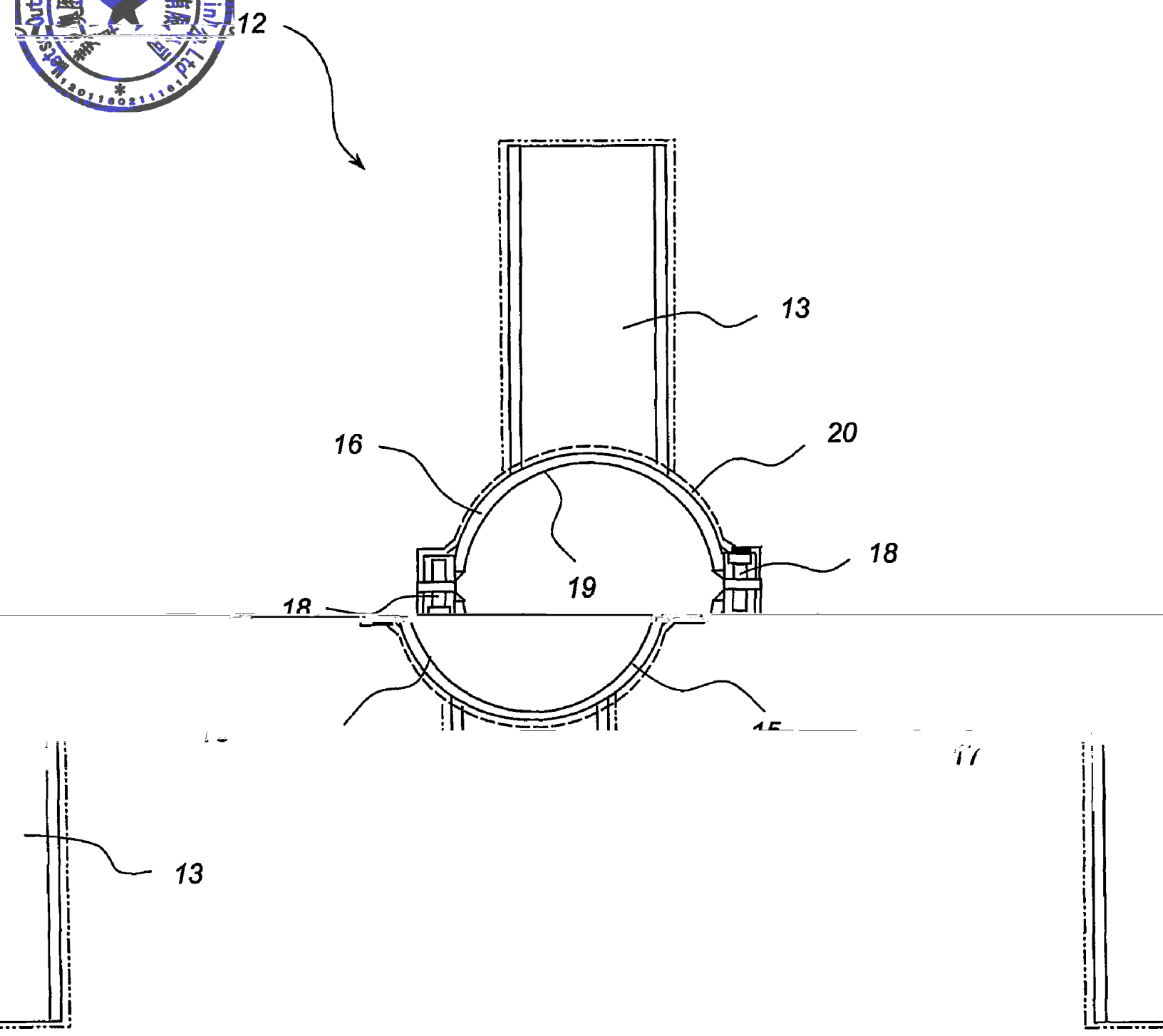


Figure 1

Figure 2



re 3

Fig

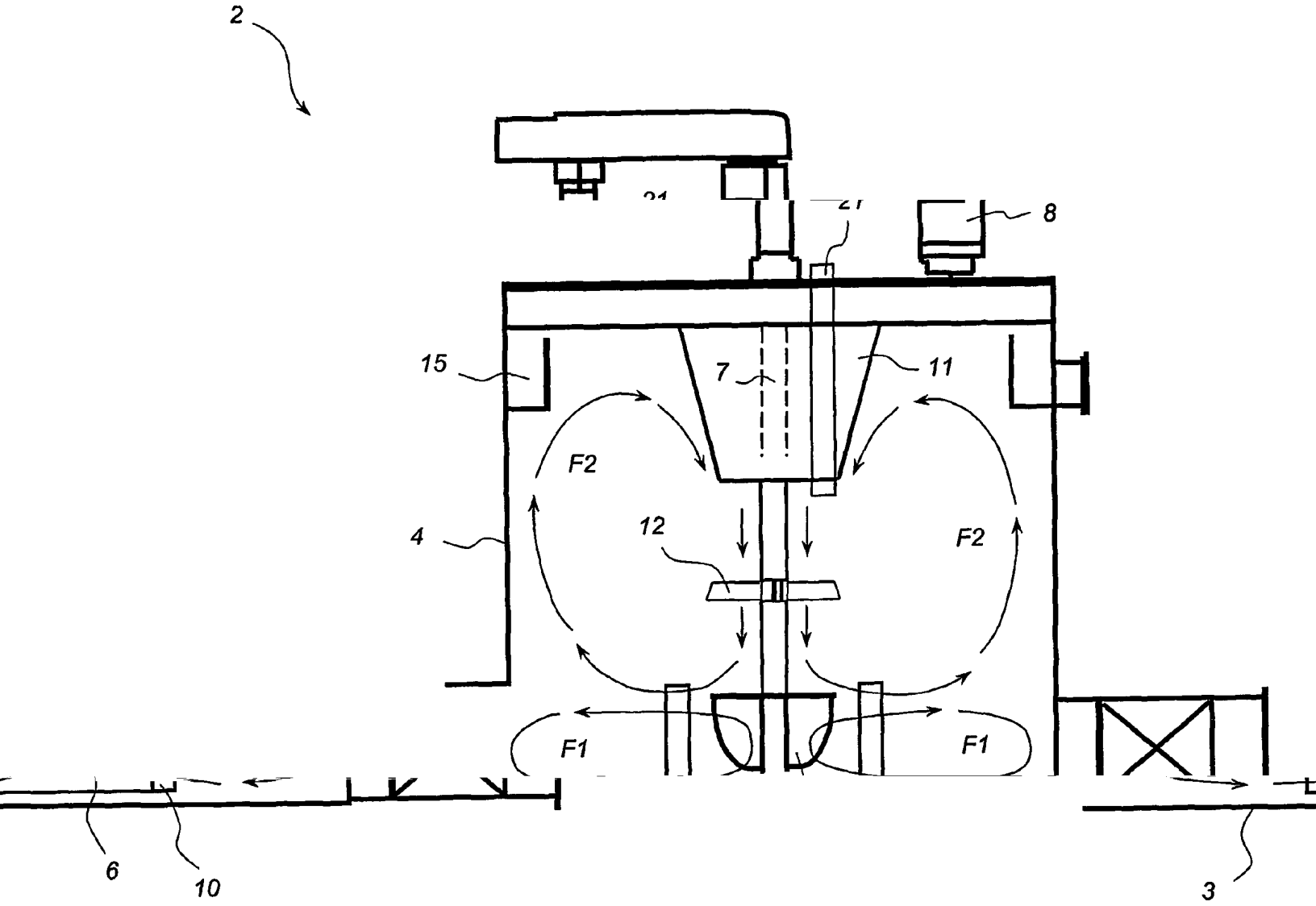


Figure 4

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.

or the like. An agitator, comprising a rotor housed ator, is normally disposed within the tank to agitate An aeration system is also provided to direct air sure into the agitator through a central conduit thin the drive shaft. Suitable reagents are also ch coat the surfaces of the mineral particles within o 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

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 means, and a drive shaft disposed intermediate the means and the primary rotor, the auxiliary agitator including:

an auxiliary agitation blade adapted, in use, to support 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, 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 between around 5 mm and around 7 mm thick.

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

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

a drive shaft;

a primary rotor connected to one end of the drive shaft to

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

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 [illegible] for recovering mineral enriched froth from the surface.

Preferably, the aeration system includes an air blower and a fluid conduit for directing air from the blower into the rotor. 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 together by [illegible] 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** [illegible]

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 **F1**. 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 [illegible] enriched surface froth. As the froth flows [illegible] it is directed radially outwardly by the [illegible] recovery through the overflow launder.

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 [illegible] 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 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 [illegible] 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 ... flotation cells or Skim Airvelles ... auxiliary agitation blade is connected to the drive shaft by at ... as

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 ... on specific system parameters.

9. The flotation device according ... specific system parameters including ...

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 flot ... fluid conduit ... underneath.

26. The flota ... stator surroun...

27. The flot ... agitator is ada... prising water, ...

28. The flota ... froth deflectio... cent the top o... being at its lo...

29. The flota ...

n device according to claim **1**, wherein the isposed to direct air into the rotor from

n device according to claim **1**, comprising a the rotor.

n device according to claim **1**, wherein the for use in a three phase environment com- ds and air.

n device according to claim **1**, comprising a one extending around the drive shaft adja- e tank, the smallest diameter of the cone most end nearest the rotor.

n device according to claim **28**, comprising ... of the tank and wherein the deflection cone is disposed to deflect froth outwardly toward the overflow launder for ... adjustable depending ... 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 ... a reagent addition tube ex... through the deflection con...

33. The flotation device ... agitating a slurry containi...

34. The flotation device ... tank has a capacity of at le...

35. The flotation device ... auxiliary agitation blade l... around 35% of the tank di...

claim **8**, wherein the ... cosity and flow characteristics within the tank.

ording to claim **28**, comprising ing downwardly into the tank

ording to claim **1**, adapted for p to around 55% solids.

ording to claim **1**, wherein the 50 m^3.

ording to claim **1**, wherein said a diameter of around 15% to ter.

* * *

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United States Patent

Niitti

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

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(30) **Foreign Application Priority Data**

Oct. 7, 2004 (FI) 20041307

(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

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

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

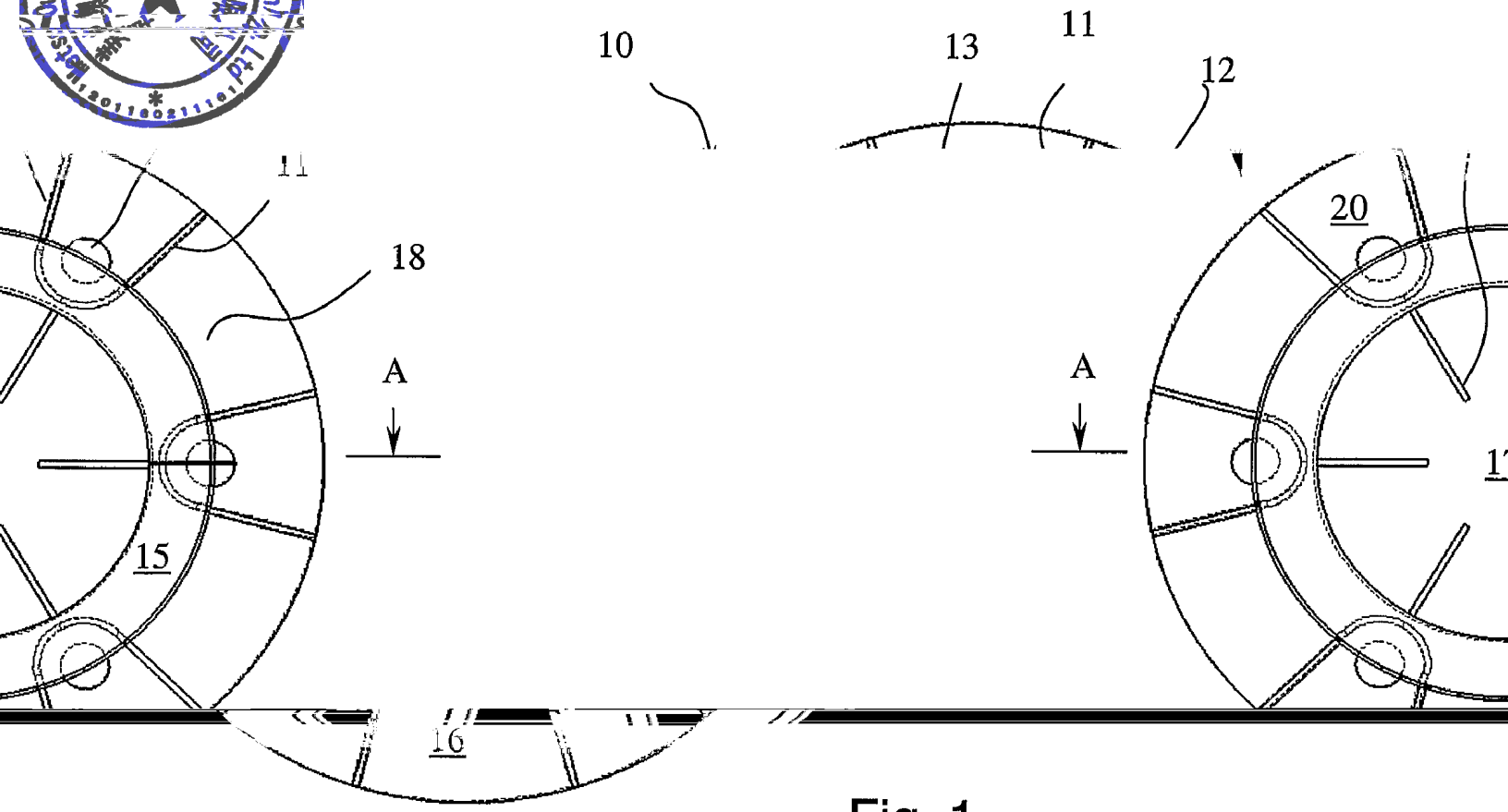

Fig. 1

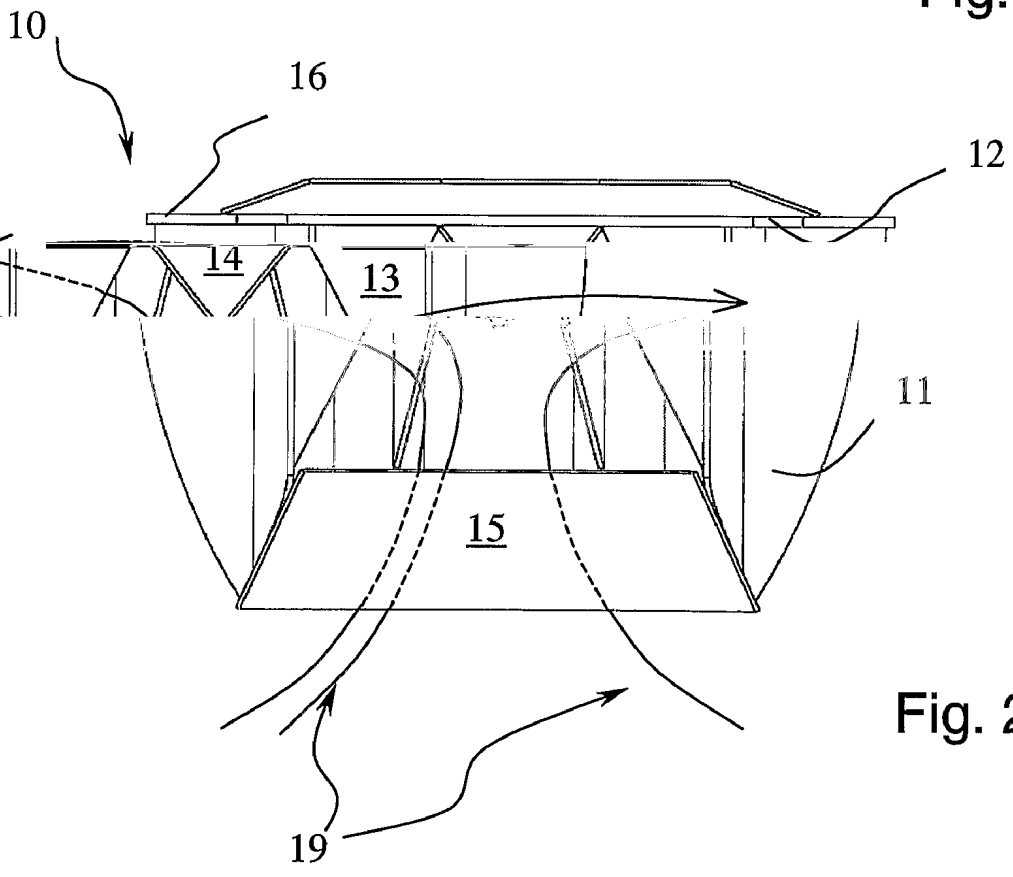

Fig. 2

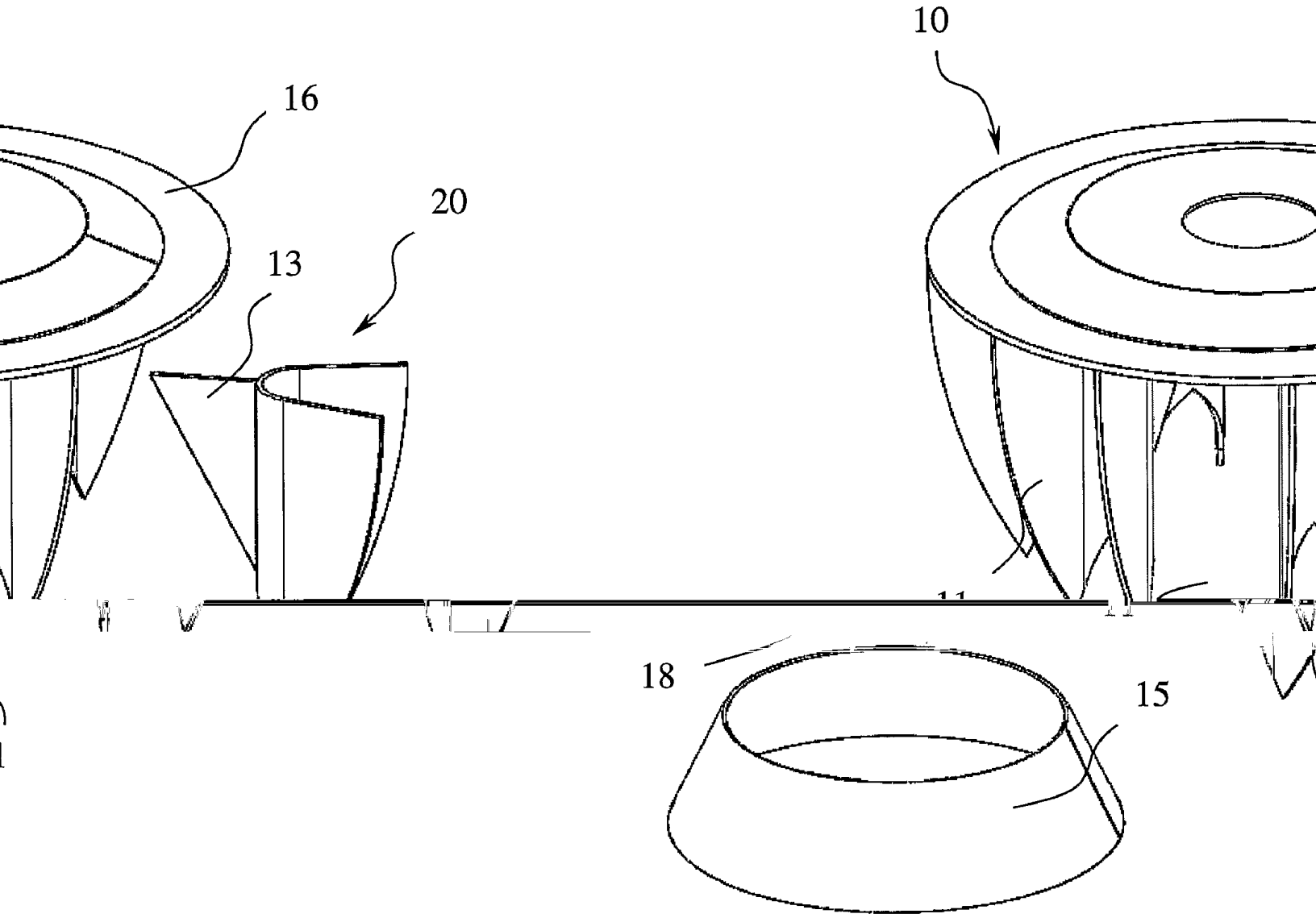

Fig. 3

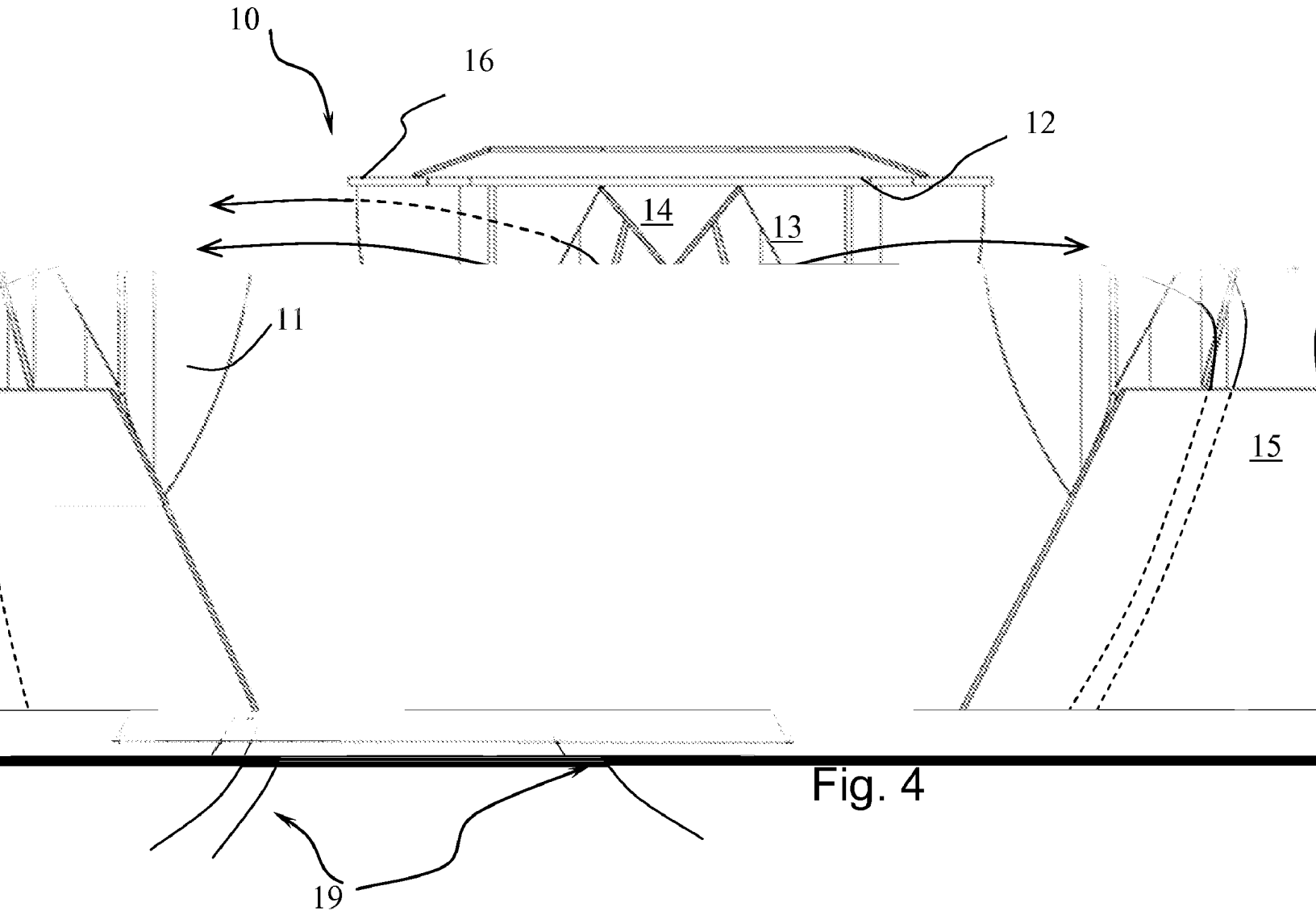

Fig. 4

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 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.

[illegible] 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. 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 [illegible] air into the air duc[illegible] encircle part of th[illegible] cell in motion and

A flotation mac[illegible] ents, such as metal[illegible] cell provided with [illegible] cell, and an outlet [illegible] rial, i.e. tailings or

Typically, the rotating shaft is hollow[illegible] channel for dispersion air to flow into th[illegible] ducts are essentially vertical and arrange[illegible] distances from one another. According [illegible] the invention the air ducts are open at th[illegible] closed at the upper ends by the cover dis[illegible]

According to one preferred embodim[illegible] invention the number of the air ducts ar[illegible] disc and installed at equal distances from[illegible] higher and the height of the air ducts is 4[illegible] of the cover disc. The air duct walls are [illegible] divergent, and they are advantageously d[illegible] center of the rotor axis, so that the wall ex[illegible] the center point of the rotor. Thus the air d[illegible] form an angle of 15-30 degrees. In additio[illegible] air ducts preferably ensures that the air du[illegible] with respect to the slurry extends essentia[illegible] the cover disc to the bottom of the rotor. T[illegible] fed through the air ducts into the slurry e[illegible] whole height of the rotor.

The slurry grooves and the internal slu[illegible] rotor and form vertical mixing and pumping blad[illegible] rotor. The air ducts are arranged at essentially equal[illegible] from one another. The air ducts define a space for th[illegible] the interior of the rotor and the outer surface of th[illegible] walls define slurry grooves that alternate with the [illegible] The air duct walls are mutually divergent and dive[illegible] each other in the direction proceeding outwardly [illegible] center part of the rotor. The outer edges of the air [illegible] define the periphery of the r[illegible] of the rotor preferably decre[illegible] rotor. Air is conducted via a[illegible] into the air ducts.

The present invention pro[illegible] dispersion mechanism of a f[illegible] present invention is efficien[illegible] the bottom of the flotation [illegible] dispersion that makes the [illegible] persed bubbles to get into [illegible] invention is to improve the [illegible] 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.

[illegible] r channels are arranged for conducting [illegible] A collar is arranged inside the rotor to [illegible] rry space and to guide the slurry flow [illegible] ispersing air into the slurry.

[illegible] e used for recovering valuable ingredi- [illegible] centrates, usually comprises a flotation [illegible] nlet aperture for feeding slurry into the [illegible] rture for letting the non-flotated mate- [illegible] providing an air [illegible] tor. Often, the air [illegible] essentially equal [illegible] embodiment of [illegible] lower ends and [illegible] of the present [illegible] ed to the cover [illegible] h other is six or [illegible] % of the radius [illegible] erably mutually [illegible] ted towards the [illegible] ions intersect at [illegible] walls preferably [illegible] he design of the [illegible] scharge surface [illegible] uniformly from [illegible] efore, air can be [illegible] tially along the [illegible] pace defined by [illegible] ances [illegible] rry in [illegible] r duct [illegible] ducts. [illegible] form [illegible] m the [illegible] walls. [illegible] . The cross sectional diameter [illegible] s towards the lower end of the [illegible] hannels from the hollow shaft [illegible] es an improved rotor for a gas [illegible] tion machine. The rotor of the [illegible] preventing sanding effect on [illegible] ine and provides efficient gas [illegible] drophobic particles and dis- [illegible] act. An object of the present [illegible] formance of a prior art rotor [illegible] 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, [illegible] mixing blades of the rotor [illegible]

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.

...and valves. Air hold-up is the ...ntained in the cell. Volume is ...ually, the volume is measured ...lume. The higher the quantity ...are for bubble-particle attach-ment. 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

...r of the disc a distance that is ...s of the cover disc **16**. ...lly divergent and the extension ...med is: ...dispersion mechanism to be used in a ...e rotor comprising: ...achment to a rotatable shaft, ...g downward from the cover disc in an ...the rotor for delivering air to the periph... ...or whereby the rotor defines a space for the ...rd of the air ducts, the air ducts being defined ...walls extending from the interior of the rotor ...phery of the rotor and forming mixing and ...ades of the rotor, wherein outer surfaces of ...define slurry grooves that are in fluid com... ...ry in the center part of the rotor **10**. ...ping 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** ...ding to claim **1**, wherein the collar is ...end portions of the air duct walls. ...ing to claim **1**, wherein the collar has a ...main stream... 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 th... air ducts are mutually divergent and diverge from each othe... in an angle of 15-...

8. The rotor acc... two air duct walls ... rotor.

9. The rotor acc... walls of each air ... angle in the range ...

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 embo... ment of the invention, seen from below,

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

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

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

The rotor of FIGS. **1-3** is arranged to a hollow shaft (... shown) via a cover disc **16**. Air ducts **20** are attached to... cover disc **16**. The walls defining the air ducts **20** exten... the cover disc starting from the outer edges of the cov... **16**, radially towards the c... 50% of the length of the r... The air duct walls are m... ...14 in width by t... The invention ... **1**. A rotor of a ... flotation machine ... a cover disc fo... air ducts exten... outer margin ... ery of the ... slurry in ... by air d... to the p... pumpin... the air ... that is provided for the slurry in the ... The rotor creates a ...

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 air to enter air duct may be arranged to 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 ... that is provided for the slurry in the ... communication with the space for the slurry, air channels for conducting air into the air ducts, and ... a conical disposed below the cover disc and enclosing 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 ... beyond the upper edge of the conical and are ... outward of the collar.

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 slurry flow.

Internal mixing and pu... extend from the air ducts ... this embodiment the inter... triangle plate elements sp... **11**, the ... of the cover ...

...ng blades **13** are arranged to ...ards the center of the rotor. In ...ixing and pumping blades are ...ng between the air duct walls ...e and the slurry flow guide **14**.

...MPLE

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

...egrees.

...ng to claim **1**, wherein each air duct has ...at extend substantially radially of the ...

...ng to claim **8**, wherein the two air duct ...t diverge outwardly of the rotor at an ...m 15 to 30 degrees.

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

space between the bottom plate and the top plate

ng blades protruding from each air duct towards the rotor.

tor according to claim 1, wherein the cover disc 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 internal

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

in the top plate to the apertures in the bottom plate.

* * * * *