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54. TÍTULO Metodo y aparato para separar valores metalicos

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71. SOLICITANTE wave separation Technologies LLC

DOMICILIO _____

74. APODERADO Emilio Ferrero

22. BOGOTÁ, D. C., 13 septiembre 2004

**Industria y Comercio**

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1 SOLICITUD DE:			
☒ Patente de Invención. ☐ Patente de Modelo de Utilidad.			
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2 SOLICITANTE (71)	Nombre: WAVE SEPARATION TECHNOLOGIES LLC sociedad constituida y existente bajo las leyes del estado de Nueva York, Estados Unidos de América Dirección: 10 Talbot Court, Rexford, Nueva York 12148, Estados Unidos de América Domicilio: Rexford, Nueva York, Estados Unidos de América		IDENTIFICACION C.C. ☐ NIT ☐ C.E. ☐ Otro ☐ Cual _____ Número: _____
3 REPRESENTANTE O APODERADO	Nombre: EMILIO FERRERO Dirección: Carrera 4ª. No. 72-35 Teléfono: 347 36 11 Fax:: 217 92 11 E-mail: clientes@camyp.com. Domicilio: Bogotá, Colombia.		IDENTIFICACION C.C. ☒ NIT ☐ C.E. ☐ Otro ☐ Cual _____ Número: <u>438.019</u> T.P. <u>31.929</u>
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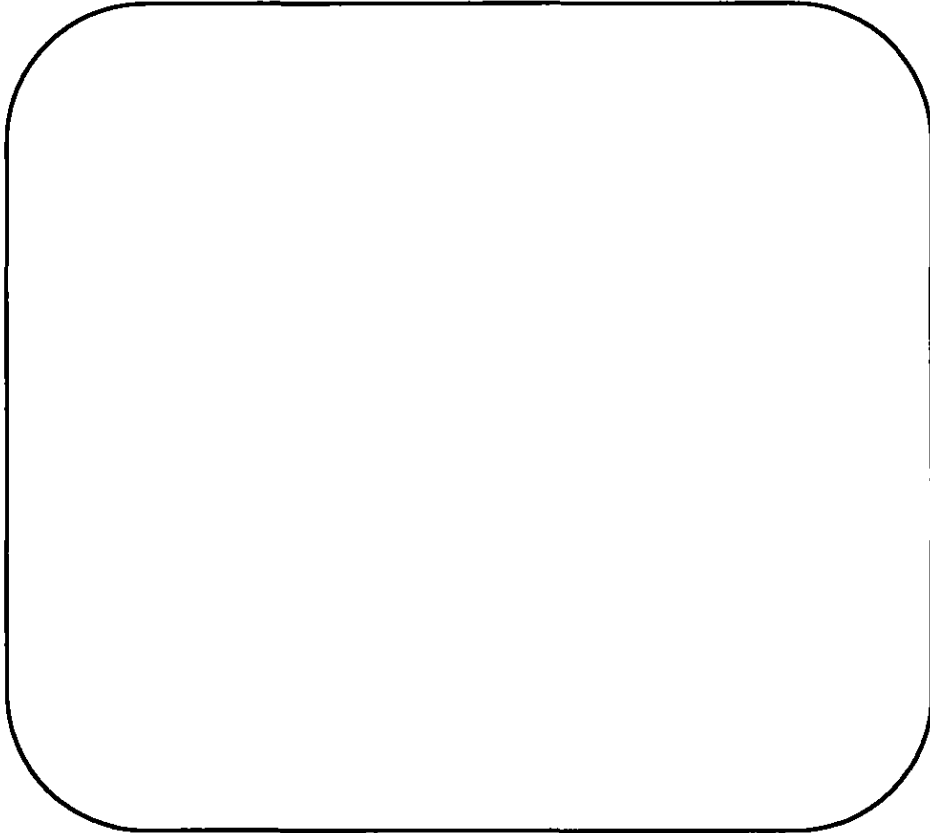
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Anexos:

- ☒ Comprobante de pago de la tasa de presentación de la solicitud por \$ 422.000.00.
- ☐ Comprobante de pago por reivindicación de prioridad.
- ☐ Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica.
- ☐ Poderes, si fuere el caso.
- ☐ Documento de cesión del inventor al solicitante o a su causante.
- ☐ Declaraciones.
- ☒ Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
- ☒ Traducción de la solicitud Internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)
- ☐ Copia del examen preliminar efectuado por la IPEA.
- ☐ Traducción del examen preliminar efectuado por la IPEA.
- ☐ De ser el caso, copia del contrato de acceso.
- ☐ De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas.
- ☐ De ser el caso, certificado de depósito del material biológico.
- ☐ Arte final 12x12
- ☐ De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas parcial o totalmente con la invención de esta solicitud.
- ☐ Otros

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FIGURA CARACTERISTICA:



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Solicito la concesión de la patente,

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(54) Title: METHOD AND APPARATUS FOR SEPARATING METAL VALUES

(57) Abstract: Methods and apparatuses for separating metal values, such as nickel and nickel compounds, from mineral ores, including lateritic ores are disclosed. The method includes providing a mixture of particles (e.g., crushed and sized ore) that is composed of at least a first group of particles and a second group of particles. Group members have similar chemical composition, while particles belonging to different groups have dissimilar chemical compositions. The mixture of particles is exposed to microwave/millimeter wave energy in order to differentially heat the first and second group of particles, thereby increasing differences in magnetic susceptibility between the first and second group of particles. The mixture of particles is then passed through a magnetic field gradient, which causes the particles to separate into magnetic and non-magnetic fractions.

METHOD AND APPARATUS FOR SEPARATING METAL VALUES

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to mineral processing, and more particularly, to a method and apparatus for separating metal values, such as nickel and nickel compounds, from mineral ores, including lateritic ores.

DISCUSSION

[0002] Nickel is an important element and is used in a variety of products. It is often combined with other metals to form stainless steels and alloy steels, nonferrous and high temperature alloys. It is also used in electroplating, catalysts, ceramics and magnets.

[0003] Though nickel can be found in many different types of mineral deposits, currently only sulfide and lateritic ores can be mined economically using existing technology. In sulfide ores, nickel, iron and copper comprise a physical mixture of distinct minerals. This allows producers to concentrate the nickel present in sulfide ores using mechanical techniques, such as flotation and magnetic separation. Lateritic ores have a significantly different structure than sulfide ores. As a result, nickel producers cannot use straightforward mechanical or physical separation techniques to concentrate the nickel in lateritic ores, but instead must use chemical separation techniques.

[0004] One of the most promising chemical methods for obtaining nickel values from lateritic ores is called high pressure acid leaching. In the method, crushed and sized lateritic ore is placed in a pressure vessel with sulfuric acid. The mixture is agitated at high temperature and high pressure (e.g., 280°C, 5.4 MPa) to leach out nickel and cobalt. The resulting liquid phase, which includes dissolved nickel and cobalt, undergoes further processing to separate nickel and cobalt.

[0005] Though a useful technology, high pressure acid leaching suffers certain disadvantages. As currently practiced, high pressure acid leaching is carried out in a batch-wise manner. Since nickel comprises only about one percent of a typical lateritic ore, the pressure vessel must be charged with large amounts of ore—e.g., one hundred tons of ore—to meet daily production requirements. This results in a large capital outlay for equipment. As compared to mechanical techniques, operating costs are high because the entire mixture must be heated to relatively high temperatures to extract a significant

fraction of nickel and cobalt from the solid phase. Finally, disposal of spent sulfuric acid raises environmental concerns.

[0006] The present invention overcomes, or at least mitigates, one or more of the problems described above.

SUMMARY OF THE INVENTION

[0007] The present invention provides methods and apparatuses for separating metal values, such as nickel and nickel compounds, from mineral ores, including lateritic ores. The inventive methods use physical processes to concentrate metal values and therefore do not raise environmental concerns associated with chemical processing. In addition, the methods are adapted to continuously process ores, which results in lower capital outlays than batch operations. Finally, the disclosed invention utilizes microwave/millimeter wave technology to selectively heat components of the ore, which helps conserve energy resources.

[0008] One aspect of the invention thus provides a method of separating components of a mixture of particles, which is comprised of at least a first group of particles and a second group of particles. Group members have similar chemical composition, while particles belonging to different groups have dissimilar chemical compositions. The method also includes exposing the mixture of particles to microwave/millimeter wave energy in order to differentially heat the first and second group of particles, thereby increasing the difference in magnetic susceptibility between the first and second group of particles. Finally, the method comprises exposing the mixture of particles through a magnetic field gradient, which causes the particles to separate into first and second fractions. The first and second fractions have, respectively, greater percentages of the first and second groups of particles than the mixture.

[0009] A second aspect of the invention provides a method of concentrating nickel values of a lateritic ore. The method comprises providing a lateritic ore comprised of a mixture of particles, and exposing the lateritic ore to microwave/millimeter wave energy in order to selectively heat particles that contain substantial amounts of nickel values. The exposure to microwave/millimeter wave energy increases the difference in magnetic susceptibility between the particles that contain substantial amounts of nickel values and particles that do not. In addition, the method includes exposing the lateritic ore through a

magnetic field gradient, which causes at least some of the particles that contain substantial amounts of nickel values to separate from the mixture of particles.

[0010] A third aspect of the invention provides an apparatus for separating components of a mixture of particles. The apparatus includes a vessel having an interior for containing the mixture of particles during processing, and an energy system coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy. The apparatus also includes a magnetic separator that communicates with the interior of the vessel. The magnetic separator is adapted to separate magnetic particles from non-magnetic particles.

[0011] A fourth aspect of the invention provides an apparatus for continuously separating components of a mixture of particles. The apparatus includes a vessel for containing the mixture of particles during processing. The vessel has a first end and a second end and an inlet located adjacent to the first end of the vessel that permits entry of the solid particles into the vessel. The apparatus also includes a gas distributor that is disposed within the vessel for fluidizing the mixture of particles, and an energy system that is coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy. Finally, the apparatus also includes a magnetic separator, which is located adjacent the second end of the vessel and which is used to separate magnetic particles from non-magnetic particles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a block diagram showing a method of separating components of a mixture of particles.

[0013] FIG. 2 is a block diagram showing a method of concentrating nickel values of a lateritic ore.

[0014] FIG. 3 is schematic view of an apparatus for separating metal values, such as nickel, from a mineral ore, including a lateritic ore.

DETAILED DESCRIPTION

[0015] FIG. 1 provides an overview of a method 10 of separating components of a mixture of particles. The method relies on heating groups of particles to different temperatures using microwave/millimeter wave energy, and then exploiting changes in magnetic susceptibility among the particles—resulting from the temperature differences—

to effect a magnetic separation of the groups of particles. The method can be used to extract metal values from mineral ores that ordinarily are not amenable to physical separation techniques. For example, and as discussed below, the method can be used to concentrate nickel values from lateritic ores without the high temperatures, high pressures, and harsh acidic conditions associated with acid leaching. Unless clear from the context of the discussion, the terms "nickel," "cobalt," and "iron" or "nickel values," "cobalt values," and "iron values," etc. may refer, respectively, to nickel, cobalt and iron atoms or to compounds that contain nickel, cobalt and iron atoms.

[0016] As shown in FIG. 1, the method 10 includes providing 12 a mixture of particles in an enclosure, vessel or cavity. The mixture of particles is comprised of at least a first group of particles and a second group of particles. Individual particles that belong to a particular group—i.e., first group, second group, etc.—have similar chemical composition, whereas particles that belong to different groups have dissimilar chemical compositions. Thus, for example, crushed and sized lateritic ore may comprise a first group of particles that contain predominantly nickel oxide, a second group of particles that contain predominantly cobalt oxide, a third group of particles that contain iron oxide (FeO) and a fourth group of particles that contain comparatively valueless earth (gangue). Individual nickel oxide, cobalt oxide or iron oxide particles may include gangue, as well as minor portions of other metal oxides.

[0017] Besides providing a mixture of particles, the method 10 also includes exposing 14 the mixture to microwave/millimeter wave energy. Since dissimilar substances generally absorb microwave/millimeter wave radiation in differing amounts, exposing the mixture of particles to microwave/millimeter wave radiation, results in differential or selective heating of the groups of particles. Moreover, for many substances, including ferromagnetic and antiferromagnetic materials, magnetic susceptibility (i.e. the ratio of the induced magnetization to magnetic field intensity) depends on the temperature of the material. For instance, a ferromagnetic material will lose all magnetic properties above its Curie temperature and an antiferromagnetic material will exhibit maximum magnetic susceptibility at its Néel temperature. Nickel oxide, for example, should exhibit maximum magnetic susceptibility at its Néel temperature, which ranges from about 260°C to about 377°C, and FeO should exhibit maximum magnetic susceptibility at its Néel temperature, which is about -75°C.

[0018] As noted above, the method 10 shown in FIG. 1 utilizes changes in magnetic susceptibility among the particles to separate the groups of particles. Thus, the method 10 includes exposing 16 the mixture of particles to a magnetic field gradient, which causes the particles to separate into first and second fractions. The first and second fractions are comprised primarily of the first and second groups of particles, respectively. Thus, for example, the first group of particles may comprise nickel oxide particles, which have been selectively heated to about their Néel temperature. The second group of particles may comprise gangue (e.g., silicon dioxide) and the like which have been heated to a lesser extent. When the mixture of particles are exposed to the magnetic field gradient, the nickel oxide particles tend to align themselves with the lines of force that comprise the magnetic field gradient, whereas the non-nickel particles remain relatively unaffected by the magnetic field gradient. Since the nickel oxide particles follow the lines of magnetic force, the method 10 diverts nickel oxide particles away from the primary flow direction of the mixture of particles.

[0019] Effective separation will depend on many factors, including the size distribution of the mixture of particles, differences in magnetic susceptibility among the groups of particles, the intensity of the applied magnetic field gradient, and so on. Depending on the type of magnetic separator used, the particle sizes of the base material (e.g., the mineral ore) usually range from about 10^{-1} microns to about 10^4 microns. For high gradient magnetic separators, which can apply magnetic field gradients up to about 25×10^6 G/cm, the particle sizes of the base material typically fall within the lower portion of the particle size range—i.e., from about 10^{-1} microns to about 10^2 microns. For other types of dry magnetic separators, which can apply magnetic field gradients between about 10^2 G/cm and 10^5 G/cm, the particles sizes of the base material ordinarily fall within the upper portion of the particle size range.

[0020] In many cases, only one of the groups of particles will exhibit measurable magnetic susceptibility following exposure to microwave/millimeter wave energy and that group will be the valuable component. In other cases, the valuable component may exhibit negligible magnetic susceptibility, while the remaining particles are magnetic. In instances when two or more groups of particles exhibit substantial magnetic susceptibility, and only one of the group of particles is of interest, microwave/millimeter wave exposure can be adjusted to maximize the differences in magnetic susceptibility among the particles of

interest and the other particles of the mixture. Since the magnitude of magnetic susceptibility of a material at its Néel temperature is generally weaker than a ferromagnetic material below its Curie temperature, the method 10 often employs a high gradient magnetic separator.

[0021] The method 10 may include other optional steps. For example, the method 10 may include contacting the mixture of particles with an inert or reactive gas. Such contacting may be desirable for many reasons. For example, the method 10 may employ a gas to fluidize the particles, which as described below, helps convey the mixture of particles through process equipment. Alternatively or additionally, the method 10 may use a gas to strip impurities from the solid particles, to form desired reaction products, and the like.

[0022] Turning now to an exemplary application, FIG. 2 illustrates a method 100 of concentrating nickel values of a lateritic ore. It should be noted, however, that with suitable modification the method 100 could be used to concentrate many different metal values from a variety of mineral ores. As shown in FIG. 2, the method 100 includes providing 102 a lateritic ore comprised of a mixture of particles. This step may comprise a variety of tasks, including extraction of the lateritic ore from the earth, transportation and storage of the mined ore, and the like. In addition, since effective magnetic separation requires that the component or components of interest comprise discrete particles, the providing step may include liberating the component of interest from the ore matrix—here, nickel oxide—by crushing, grinding (if necessary), and sizing (e.g., screening) the ore particles.

[0023] After the particles are crushed and ground to the requisite size, which for a typical lateritic ore is less than about 20 mesh or about 1.3 mm, the ore is exposed 104 to microwave/millimeter wave energy in order to selectively heat particles that contain substantial amounts of nickel values. By selectively heating the nickel oxide particles, the method 100 increases the difference in magnetic susceptibility between particles that contain substantial amounts of nickel values and particles that do not. For nickel oxide, this corresponds to heating the particles to their Néel temperature, which is between about 260°C and 377°C. It should be understood that the nickel oxide particles could be heated to temperatures different than the Néel temperature (e.g., between 150°C and 300°C) so long as they attain the desired level of magnetic susceptibility.

[0024] The method 100 also includes exposing 106 the lateritic ore to a magnetic field gradient, which causes at least some of the particles that contain substantial amounts of nickel values to separate from the mixture of particles. Besides nickel values, lateritic ores generally contain other metal values, which will likely have been selectively heated to a temperature different than their Néel temperatures. These particles may retain residual magnetic susceptibility so that during the magnetic separation step, some of them may be entrained by the nickel oxide particles. The resulting concentrated nickel values, and perhaps a small fraction of entrained metal values, may undergo further processing (refining, smelting, etc.) or can be sold as a finished product.

[0025] FIG. 3 shows an apparatus 200 that can be used carryout the processes 10, 100 shown in FIG 1 and FIG. 2, respectively. The apparatus 200 comprises a vessel 202, which contains the mixture of particles (e.g., crushed and sized ore) during processing. As indicated by arrows 204, 206, the mixture of particles and a gas (typically compressed air, which may be cooled or heated) enter the vessel 202 via ports 208, 210 at a first end 212 of the vessel 202. The gas dumps into a plenum 214 and flows upward through a gas distributor 216 (i.e., grating or perforated plate) that spans the distance between the sides and the first 212 and second 218 ends of the vessel 202.

[0026] The solid particles, which are shown schematically as circles 220 in FIG. 3, travel from the first 212 to the second 218 ends of the vessel 202 along the gas distributor 216. To help convey the solid particles 220 between the ends 212, 218 of the vessel 202, the gas flowing upward through the distributor 216 lifts the particles 220, producing a fluidized bed 222 that behaves in a manner similar to a liquid. The gas used to fluidize the particles 220, flows into a disengaging space 224 and exits the vessel 202 via a port 226. A conduit 228 channels the gas into a dust separator 230 (e.g., cyclone) that removes any entrained solids 232 from the gas stream 234. In addition to acting as a fluidizing medium, the gas may strip off impurities, provide a surface coating, react to form a desired product, and so on.

[0027] The apparatus 200 includes an energy system 236, which can be used to expose the particles 220 to microwave/millimeter wave energy via a radiative technique. The system 236 includes a source 238 of microwave/millimeter wave energy and an applicator 240, which is disposed within the vessel 202. The system 236 also includes a waveguide 242, which directs the microwave/millimeter wave energy from the source 238 to the

applicator 240. As used in this disclosure, microwave/millimeter wave energy refers to energy having frequencies as low as 100 MHz to as high as 3000 GHz. For a discussion of useful systems for generating and applying microwave/millimeter wave energy to process materials, see U.S. Patent Nos. 4,894,134; 5,784,682; and 6,090,350, which are herein incorporated by reference in their entirety and for all purposes.

[0028] As can be seen in FIG. 3, after the particles 220 have been differentially heated through exposure to microwave/millimeter wave energy from the applicator 240, they reach the second end 218 of the vessel 202 where they pass through a magnetic separator 244. As indicated by arrows 246, 248, the magnetic separator diverts magnetic particles 250 (i.e., those having a threshold magnetic susceptibility) away from the non-magnetic particles thereby concentrating the magnetic particles (or non-magnetic particles). As noted above, high gradient magnetic separators are especially useful, but depending on the magnetic susceptibility of the magnetic particles 250, other devices can be used. For a discussion of useful magnetic separators, see Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Handbook," pp. 19-40 to 19-49 (7th Ed., 1997).

[0029] Although the apparatus 200 shown in FIG. 3 utilizes a fluidized bed 222 to convey individual particles 220 between the ends 212, 218 of the vessel 202, other devices can be used. For example, some embodiments may use moving belts, which can be coupled to a magnetic pulley at the second end 218 of the vessel 202 for carrying out the magnetic separation. Other embodiments may rely on gravity to convey particles and may include a gas distribution system for contacting the particles with an inert or reactive gas to strip impurities from the particles, form desired reaction products, modify the surfaces properties of the particles, and the like. The apparatus 200 shown in FIG. 3 is adapted to continuously process mixtures of particles, which minimizes the requisite size of the vessel 202 and hence capital expenditures. However, other apparatuses may be used that operate in a batch or semi-batch mode, which would likely result in higher capital and labor costs, but may result in greater recovery of the material of interest.

[0030] Other embodiments may channel the magnetic particles 250 into a second vessel (not shown) where the particles 250 undergo further treatment. Like the apparatus 200 shown in FIG. 3, the second vessel may include the necessary structures for heating the particles 250 (e.g., microwave/millimeter wave source) and for contacting the magnetic particles 250 with an inert or reactive gas (e.g., gas distributor). Such an apparatus could

employ a gas that may be the same as or different than any fluidizing gas used, and which includes sulfur (e.g., hydrogen sulfide) in order to convert nickel oxide to nickel sulfide.

[0031] It should be understood that the above description is intended to be illustrative and not limiting. Many embodiments will be apparent to those of skill in the art upon reading the above description. Therefore, the scope of the invention should be determined, not with reference to the above description, but instead with reference to the appended claim, along with the full scope of equivalents to which such claim is entitled. The disclosures of all patents, articles and references, including patent applications and publications, if any, are incorporated herein by reference in their entirety and for all purposes.

WHAT IS CLAIMED IS:

1. A method of separating components of a mixture, the method comprising:
providing a mixture of particles, the mixture comprised of at least a first group of particles and a second group of particles, the first group of particles having a different chemical composition than the second group of particles;
exposing the mixture of particles to microwave/millimeter wave energy in order to differentially heat the first and second group of particles, thereby increasing the difference in magnetic susceptibility between the first and second group of particles; and
exposing the mixture of particles to a magnetic field gradient, the magnetic field gradient causing the particles to separate into first and second fractions, the first fraction having a greater percentage of the first group of particles than the mixture, and the second fraction having a greater percentage of the second group of particles than the mixture.
2. The method of claim 1, wherein the mixture of particles is a lateritic ore.
3. The method of claim 1, wherein the first group of particles includes one or more metal values.
4. The method of claim 3, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the first group of particles to approximately the Néel temperature of one of the metal values.
5. The method of claim 3, wherein the first group of particles includes one or more nickel values.
6. The method of claim 1, further comprising a third group of particles that includes one or more cobalt values.
7. The method of claim 1, further comprising contacting the mixture of particles with a gas.
8. The method of claim 1, further comprising fluidizing the mixture of particles.

9. A method of concentrating nickel values of a lateritic ore, the method comprising:

providing a lateritic ore comprised of a mixture of particles;

exposing the lateritic ore to microwave/millimeter wave energy in order to selectively heat particles that contain substantial amounts of one or more nickel values, thereby increasing the difference in magnetic susceptibility between the particles that contain substantial amounts of nickel values and particles that contain insubstantial amounts of nickel values;

exposing the lateritic ore to a magnetic field gradient, causing at least some of the particles that contain substantial amounts of nickel values to separate from the mixture of particles.

10. The method of claim 9, wherein the nickel values are nickel oxides.

11. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to approximately the Néel temperature of at least one of the nickel values.

12. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to a temperature of at least about 150°C.

13. The method of claim 9, wherein exposing the mixture of particles to microwave/millimeter wave energy further comprises heating at least a portion of the particles that contain substantial amounts of nickel values to a temperature of at least about 250°C.

14. The method of claim 9, further comprising contacting the mixture of particles with a gas.

15. The method of claim 9, further comprising fluidizing the mixture of particles.

16. An apparatus for separating components of a mixture of particles, the apparatus comprising:
- a vessel having an interior for containing the mixture of particles during processing;
 - an energy system coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy; and
 - a magnetic separator communicating with the interior of the vessel for separating magnetic particles from non-magnetic particles.
17. The apparatus of claim 16, further comprising a gas distributor for contacting the mixture of particles with a gas.
18. The apparatus of claim 16, further comprising a gas distributor for fluidizing the mixture of particles.
19. The apparatus of claim 16, further comprising a second vessel having an interior in communication with the magnetic separator.
20. The apparatus of claim 19, further comprising a gas distributor for contacting particles contained in the interior of the second vessel with a gas.
21. The apparatus of claim 20, further comprising a source of gas in fluid communication with the gas distributor, wherein the source of gas includes sulfur or a sulfur containing compound.
22. The apparatus of claim 19, further comprising a gas distributor for fluidizing particles contained in the interior of the second vessel.

23. An apparatus for separating components of a mixture of particles, the apparatus comprising:

a vessel for containing the mixture of particles during processing, the vessel having a first end and a second end and an inlet located adjacent to the first end of the vessel that permits entry of the solid particles into the vessel;

a gas distributor disposed within the vessel for fluidizing the mixture of particles;

an energy system coupled to the vessel for exposing the mixture of particles to microwave/millimeter wave energy; and

a magnetic separator located adjacent the second end of the vessel for separating magnetic particles from non-magnetic particles.

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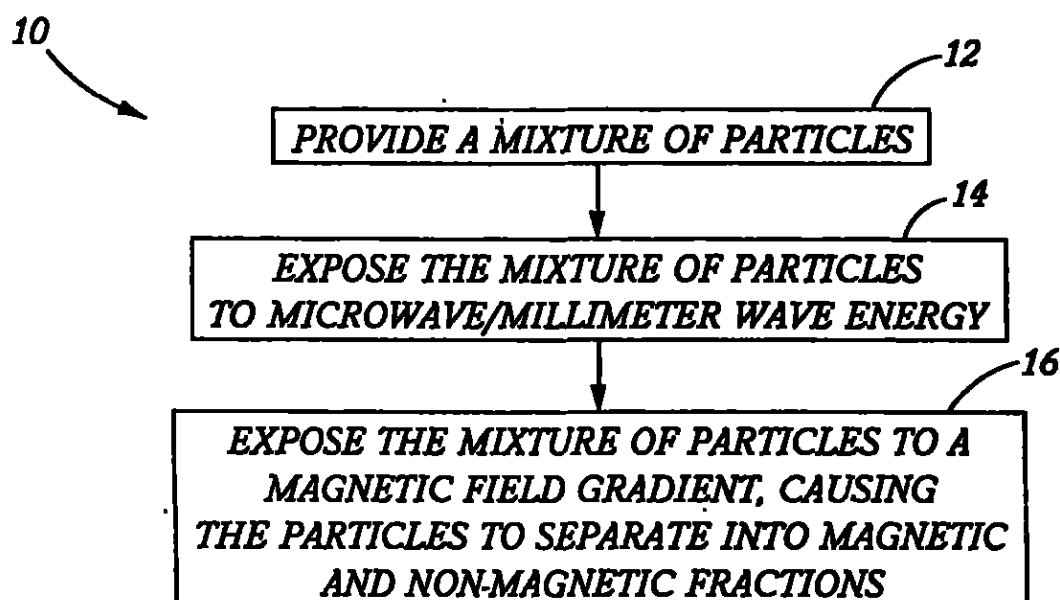


FIG. 1

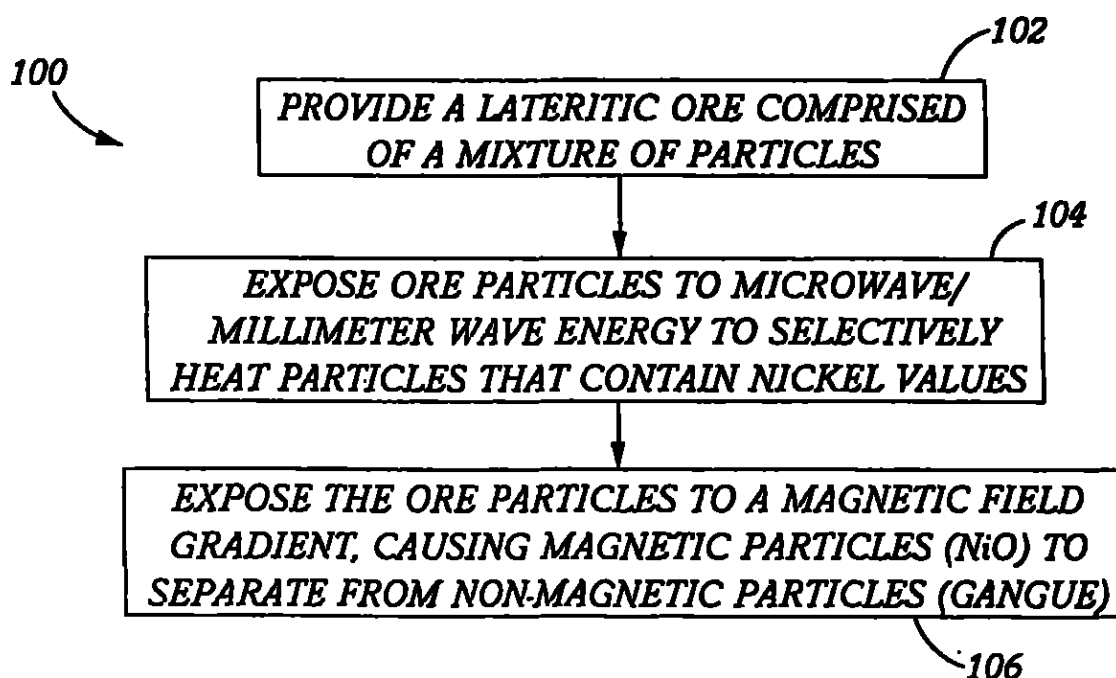


FIG. 2

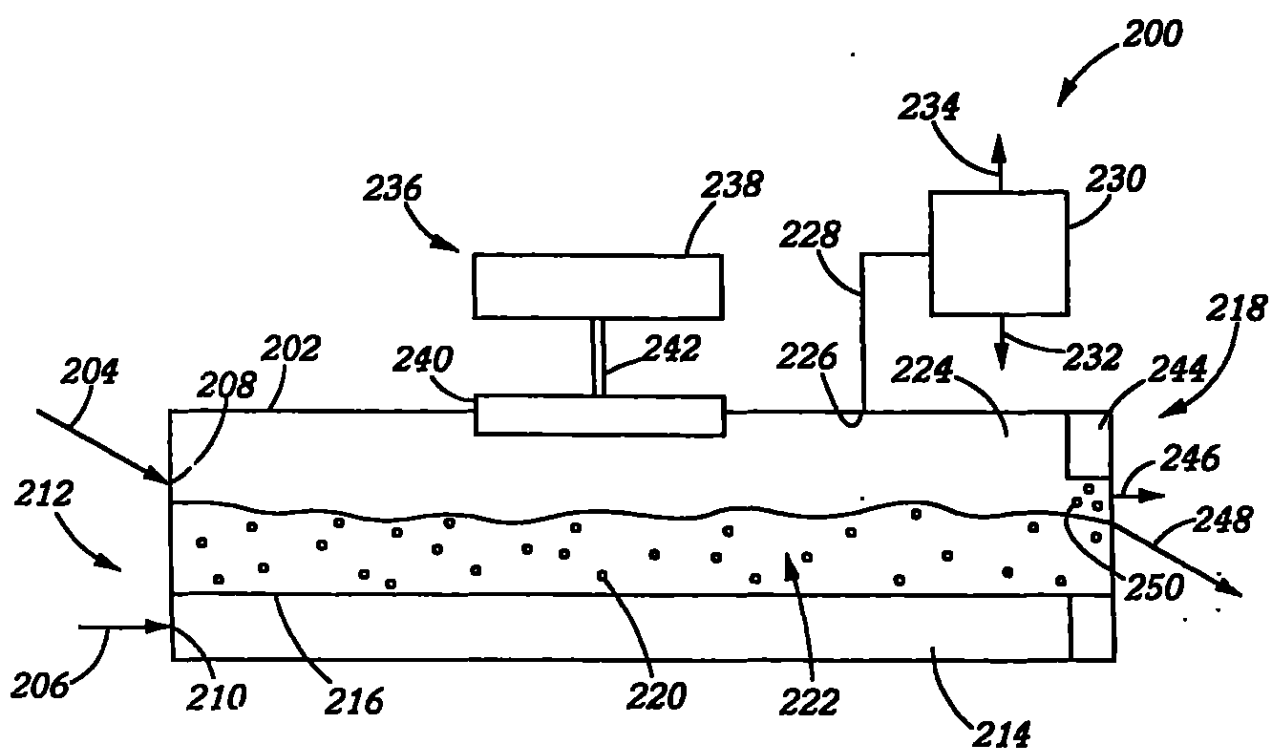


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/04740

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :C22B 23/00; B03C 1/00

US CL :209/8, 11, 214; 423/151, 152

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 209/8, 11, 214; 423/151, 152

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST: microwav\$6, magneti\$3, heat\$4, separat\$4, particle\$3

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,463,310 A (ERGUN et al) 26 August 1969, col. 2, claims 1-14.	1,3,4,7,16,17
X	US 4,678,478 A (KELLAND) 07 July 1987, claims 8-15.	1,3,4,7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Z" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 05 MAY 2003	Date of mailing of the international search report 7 MAY 2003
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 505-3230	Authorized officer STEVEN BOS <i>Amf Walby</i> Telephone No. 703-308-0861

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/04749

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: JOSEPH V. COPPOLA
RADER, FISHMAN & GFRAUER PLLC
39533 WOODWARD AVENUE
SUITE 140
BLOOMFIELD HILLS, MI 48304

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

Date of Mailing
(day/month/year)

/ 27 MAY 2003

Applicant's or agent's file reference

65641-0018

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT/US03/04749

International filing date
(day/month/year)

19 FEBRUARY 2003

Applicant

WAVE SEPARATION TECHNOLOGIES LLC

1. ☒ The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes
1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. Reminders

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later); otherwise the applicant must, within 20 months from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of 30 months (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20531

Facsimile No. (703) 305-3230

Authorized officer

STEVEN BOS

Telephone No. 703-308-0661

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 65841-0018	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/280) as well as, where applicable, item 5 below.
International application No. PCT/US03/04749	International filing date (day/month/year) 18 FEBRUARY 2003	(Earliest) Priority Date (day/month/year) 22 FEBRUARY 2002
Applicant WAVE SEPARATION TECHNOLOGIES LLC		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 25.1(b)).

b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the title,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. _____

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

☒ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/04749

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐
☐

- The additional search fees were accompanied by the applicant's protest.
No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/04749

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :C22B 23/00; B03C 1/00

US CL :209/8, 11, 214; 423/151, 152

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 209/8, 11, 214; 423/151, 152

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST: microwav\$6, magneti\$3, heat\$4, separat\$4, particle\$5

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,463,310 A (ERGUN et al) 26 August 1969, col. 2, claims 1-14.	1,3,4,7,16,17
X	US 4,678,478 A (KELLAND) 07 July 1987, claims 8-15.	1,3,4,7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"A" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

05 MAY 2003

Date of mailing of the international search report

27 MAY 2003

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

STEVEN BOS

Telephone No. 703-308-0681

NOTES TO FORM PCT/ISA/220 (continued)

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

The statement should be brief, it should not exceed 500 words if in English or if translated into English.

It should not be confounded with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)".

It should not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report, may be made only in connection with an amendment of that claim.

In what language?

The amendments must be made in the language in which the international application is published. The letter and any statement accompanying the amendments must be in the same language as the international application if that language is English or French; otherwise, it must be in English or French, at the choice of the applicant.

Consequence if a demand for international preliminary examination has already been filed?

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase?

The applicant's attention is drawn to the fact that, when upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty and of the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the letter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended ?

The claims only.

The description and the drawings may only be amended during international preliminary examination under Chapter II.

When ? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments ?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How ? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

What documents must/may accompany the amendments ?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the amendment of a claim as filed.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) 65641-0018

Box No. I TITLE OF INVENTION METHOD AND APPARATUS FOR SEPARATING METAL VALUES	
Box No. II APPLICANT ☐ This person is also inventor	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) WAVE SEPARATION TECHNOLOGIES LLC 10 Talbot Court Rexford, New York 12148 US	Telephone No. (518) 383-4556 Facsimile No. (518) 348-1382 Teleprinter No. Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.) BIRKEN, Stephen 10 Talbot Court Rexford, New York 12148 US	This person is: ☐ applicant only ☒ applicant and inventor ☐ inventor only (If this check-box is marked, do not fill in below.) Applicant's registration No. with the Office
State (that is, country) of nationality: US	State (that is, country) of residence: US
This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box	
☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) COPPOLA, Joseph V., BASCOBERT, Michael R. Rader, Fishman & Grauer PLLC 39533 Woodward Avenue Suite 140 Bloomfield Hills, Michigan 48304 US	Telephone No. (248) 594-0600 Facsimile No. (248) 594-0610 Teleprinter No. Agent's registration No. with the Office 33,373
☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Box No. V DESIGNATION OF STATES

Mark the applicable check-boxes below; at least one must be marked.

The following designations are hereby made under Rule 4.9(a):

Regional Patent

- ☒ **AP** ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT (if other kind of protection or treatment desired, specify on dotted line)
- ☒ **EA** Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** European Patent: AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | | |
|---|--|---|
| ☒ AE United Arab Emirates | ☒ GM Gambia | ☒ NZ New Zealand |
| ☒ AG Antigua and Barbuda | ☒ HR Croatia | ☒ OM Oman |
| ☒ AL Albania | ☒ HU Hungary | ☒ PH Philippines |
| ☒ AM Armenia | ☒ ID Indonesia | ☒ PL Poland |
| ☒ AT Austria | ☒ IL Israel | ☒ PT Portugal |
| ☒ AU Australia | ☒ IN India | ☒ RO Romania |
| ☒ AZ Azerbaijan | ☒ IS Iceland | ☒ RU Russian Federation |
| ☒ BA Bosnia and Herzegovina | ☒ JP Japan | ☒ SD Sudan |
| ☒ BB Barbados | ☒ KE Kenya | ☒ SE Sweden |
| ☒ BG Bulgaria | ☒ KG Kyrgyzstan | ☒ SG Singapore |
| ☒ BR Brazil | ☒ KP Democratic People's Republic of Korea | ☒ SI Slovenia |
| ☒ BY Belarus | ☒ KR Republic of Korea | ☒ SK Slovakia |
| ☒ BZ Belize | ☒ KZ Kazakhstan | ☒ SL Sierra Leone |
| ☒ CA Canada | ☒ LC Saint Lucia | ☒ TJ Tajikistan |
| ☒ CH & LI Switzerland and Liechtenstein | ☒ LK Sri Lanka | ☒ TM Turkmenistan |
| ☒ CN China | ☒ LR Liberia | ☒ TN Tunisia |
| ☒ CO Colombia | ☒ LS Lesotho | ☒ TR Turkey |
| ☒ CR Costa Rica | ☒ LT Lithuania | ☒ TT Trinidad and Tobago |
| ☒ CU Cuba | ☒ LU Luxembourg | ☒ TZ United Republic of Tanzania |
| ☒ CZ Czech Republic | ☒ LV Latvia | ☒ UA Ukraine |
| ☒ DE Germany | ☒ MA Morocco | ☒ UG Uganda |
| ☒ DK Denmark | ☒ MD Republic of Moldova | ☒ US United States of America |
| ☒ DM Dominica | ☒ MG Madagascar | ☒ UZ Uzbekistan |
| ☒ DZ Algeria | ☒ MK The former Yugoslav Republic of Macedonia | ☒ VN Viet Nam |
| ☒ EC Ecuador | ☒ MN Mongolia | ☒ YU Yugoslavia |
| ☒ EE Estonia | ☒ MW Malawi | ☒ ZA South Africa |
| ☒ ES Spain | ☒ MX Mexico | ☒ ZM Zambia |
| ☒ FI Finland | ☒ MZ Mozambique | ☒ ZW Zimbabwe |
| ☒ GB United Kingdom | ☒ NO Norway | |
| ☒ GD Grenada | | |
| ☒ GE Georgia | | |
| ☒ GH Ghana | | |

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

- | | | |
|--------------------------------|--------------------------------|--------------------------------|
| ☐ | ☐ | ☐ |
| ☐ | ☐ | ☐ |

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 22 February 2002 (22.02.02) ✓	10/080,773 ✓	US ✓		
item (2)				
item (3)				
item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office) identified above as:

☐ all items
 ☒ item (1)
 ☐ item (2)
 ☐ item (3)
 ☐ item (4)
 ☐ item (5)
 ☐ other, see Supplemental Box

* Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / US ✓

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

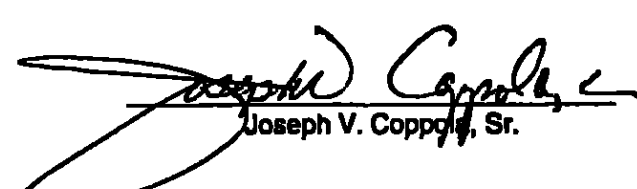
Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) (mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):

Number of
declarations

- | | | |
|---|--|---|
| ☐ Box No. VIII (i) | Declaration as to the identity of the inventor | : |
| ☐ Box No. VIII (ii) | Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent | : |
| ☐ Box No. VIII (iii) | Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application | : |
| ☐ Box No. VIII (iv) | Declaration of inventorship (only for the purposes of the designation of the United States of America) | : |
| ☐ Box No. VIII (v) | Declaration as to non-prejudicial disclosures or exceptions to lack of novelty | : |

Box No. IX CHECK LIST; LANGUAGE OF FILING		
This international application contains: (a) the following number of sheets in paper form: request (including declaration sheets) : 4 description (excluding sequence listing part) : 9 claims : 4 abstract : 1 drawings : 2 Sub-total number of sheets : 20 sequence listing part of description (actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below) : Total number of sheets : 20 (b) sequence listing part of description filed in computer readable form (i) ☐ only (under Section 801(a)(i)) (ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii)) Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained (additional copies to be indicated under item 9(ii), in right column):		This international application is accompanied by the following item(s) (mark the applicable check-boxes below and indicate in right column the number of each item): 1. ☒ fee calculation sheet : 2. ☐ original separate power of attorney : 3. ☐ original general power of attorney : 4. ☐ copy of general power of attorney; reference number, if any: : 5. ☐ statement explaining lack of signature : 6. ☐ priority document(s) identified in Box No. VI as item(s): : 7. ☐ translation of international application into (language): : 8. ☐ separate indications concerning deposited microorganism or other biological material : 9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other)) : (i) ☐ copy submitted for the purposes of international search under Rule 13ter only (and not as part of the international application) : (ii) ☐ (only where check-box (b)(i) or (b)(ii) is marked in left column) additional copies including, where applicable, the copy for the purposes of international search under Rule 13ter : (iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column : 10. ☒ other (specify): Return Receipt Postcard :
Figure of the drawings which should accompany the abstract: 3	Language of filing of the international application: English	

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).  Joseph V. Coppola, Sr.

For receiving Office use only	
1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	6. ☐ Transmittal of search copy delayed until search fee is paid
For International Bureau use only	
Date of receipt of the record copy by the International Bureau:	

This sheet is not part of and does not count as a sheet of the International application.

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International Application No.

Date stamp of the receiving Office

Applicant's or agent's
file reference

65641-0018

Applicant

WAVE SEPARATION TECHNOLOGIES LLC

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 240.00 **T**

2. SEARCH FEE 450.00 **S**

International search to be carried out by US

(If two or more International Searching Authorities are competent to carry out the international search, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

Where item (b) of Box No. IX applies, enter Sub-total number of sheets } 20
Where item (b) of Box No. IX does not apply, enter Total number of sheets }

b1 first 30 sheets 407.00 **b1**

b2 0 x 9.00 = 0 **b2**
number of sheets in excess of 30 fee per sheet

b3 additional component (only if sequence listing part of description is filed in computer readable form under Section 801(a)(i), or both in that form and on paper, under Section 801(a)(ii)):

400 x = **b3**
fee per sheet

Add amounts entered at b1, b2 and b3 and enter total at B 407.00 **B**

Designation Fees

The international application contains ALL designations.

5 x 88.00 = 440.00 **D**
number of designation fees payable (maximum 5) amount of designation fee

Add amounts entered at B and D and enter total at I 847.00 **I**

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT (if applicable) 15.00 **P**

5. TOTAL FEES PAYABLE 1,552.00

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☒ authorization to charge deposit account (see below) ☐ postal money order ☐ cash ☐ coupons
☐ cheque ☐ bank draft ☐ revenue stamps ☐ other (specify):

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT

(This mode of payment may not be available at all receiving Offices)

☒ Authorization to charge the total fees indicated above.
☒ (This check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.
☒ Authorization to charge the fee for priority document.

Receiving Office: RO/ US

Deposit Account No.: 18-0013

Date: 19 February 2003

Name: Joseph V. Ceppola, Sr.

Signature: [Signature]

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

PCT

**NOTIFICATION OF THE INTERNATIONAL
APPLICATION NUMBER AND OF THE
INTERNATIONAL FILING DATE**

(PCT Rule 20.5(c))

To:

JOSEPH V. COPPOLA
RADER, FISHMAN & GFRAUER PLLC
39533 WOODWARD AVENUE
SUITE 140
BLOOMFIELD HILLS, MICHIGAN 48304

Date of mailing
(day/month/year)

03 Apr 2003

Applicant's or agent's file reference

65641-0018

IMPORTANT NOTIFICATION

International application No.

PCT/US03/04749

International filing date (day/month/year)

19 Feb 2003

Priority date (day/month/year)

22 Feb 2002

Applicant

WAVE SEPARATION TECHNOLOGIES LLC

Title of the invention

METHOD AND APPARATUS FOR SEPARATING METAL VALUES

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:



was transmitted to the International Bureau on

03 Apr 2003



has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:



because the necessary national security clearance has not yet been obtained.



because (reason to be specified):

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

3. FOREIGN TRANSMITTAL LICENSE INFORMATION

Completed by: MB



Additional license for foreign transmittal not required. This subject matter is covered by a license already granted or the equivalent U.S. national application. Refer to that license for information concerning its scope.



License for foreign transmittal not required. 37 CFR 5.11(e)(1) or 37 CFR 5.11(e)(2). However, a license may be required for additional subject matter. See 37 CFR 5.15(b).



Foreign transmittal license granted. 35 U.S.C. 184; 37 CFR 5.11 on

29 Mar 2003

(date)



37 CFR 5.15(a)



37 CFR 5.15(b)

Name and mailing address of the receiving Office

Assistant Commissioner for Patent, Box PCT
Washington, D.C. 20231 Attn:RO/US

Facsimile No. 703-305-3230

Authorized officer

Melvin Brooks, Sr.

Telephone No. (703) 305-5163

25

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:

JOSEPH V. COPPOLA
RADER, FISHMAN & GFRAUER PLLC
39533 WOODWARD AVENUE
SUITE 140
BLOOMFIELD HILLS, MICHIGAN 48304

PCT

NOTIFICATION OF RECEIPT
OF SEARCH COPY

(PCT Rule 25.1)

Date of mailing
(day/month/year)

03 Apr 2003

Applicant's or agent's file reference

85641-0018

IMPORTANT NOTIFICATION

International application No.

PCT/US03/04749

International filing date (day/month/year)

19 Feb 2003

Priority date (day/month/year)

22 Feb 2002

Applicant

WAVE SEPARATION TECHNOLOGIES LLC

1. Where the International Searching Authority and the receiving Office are not the same Office:

The applicant is hereby notified that the search copy of the international application was received by this International Searching Authority on the date indicated below.

Where the International Searching Authority and the receiving Office are the same Office:

The applicant is hereby notified that the search copy of the international application was received on the date indicated below.

03 Apr 2003

(date of receipt)

2. ☐ The search copy was accompanied by a nucleotide and/or amino acid sequence listing in computer readable form.

3. Time limit for establishment of international search report

The applicant is informed that the time limit for establishing the international search report is 3 months from the date of receipt indicated above or 9 months from the priority date, whichever time limit expires later.

4. A copy of this notification has been sent to the International Bureau and, where the first sentence of paragraph 1 applies, to the receiving Office.

Name and mailing address of the ISA/
Assistant Commissioner for Patent, Box PCT
Washington, D.C. 20231 Attn: RO/US
Facsimile No. 703-305-3230

Authorized officer
Melvin Brooks, Sr.
Telephone No. (703) 305-5163

PATENT COOPERATION TREATY

From the RECEIVING OFFICE

To:
JOSEPH V. COPPOLA
RADER, FISHMAN & GFRAUER PLLC
39533 WOODWARD AVENUE
SUITE 140
BLOOMFIELD HILLS, MICHIGAN 48304

PCT

INVITATION TO CORRECT DEFECTS IN
THE INTERNATIONAL APPLICATION
(PCT Articles 3(4)(i) and 14(1) and Rule 26)

Applicant's or agent's file reference 85641-0018	Date of mailing <i>(day/month/year)</i> 03 Apr 2003
International application No. PCT/US03/04749	REPLY DUE within <u> 1 </u> months/days from the above date of mailing International filing date <i>(day/month/year)</i> 19 Feb 2003
Applicant WAVE SEPARATION TECHNOLOGIES LLC	

1. ☐ The applicant is hereby invited, within the time limit indicated above, to correct, in the international application as filed, the defects specified on the attached:
 - ☒ Annex A
 - ☐ Annex B1 (text matter of the international application as filed)
 - ☐ Annex C1 (drawings of the international application as filed)

2. ☐ The applicant is hereby invited, within the time limit indicated above, to correct, in the translation of the international application furnished under Rule 12.3 or 12.4, the defects specified on the attached:
 - ☐ Annex A
 - ☐ Annex B2 (text matter of the translation of the international application)
 - ☐ Annex C2 (drawings of the translation of the international application)

Additional observations (if necessary):

HOW TO CORRECT THE DEFECTS?

Correction must be submitted by filing a replacement sheet embodying the correction and a letter accompanying the replacement sheet, which shall draw attention to the difference between the replaced sheet and the replacement sheet. A correction may be stated in a letter only if it is of such a nature that it can be transferred from the letter to the record copy without adversely affecting the clarity and direct reproducibility of the sheet onto which the correction is to be transferred (Rule 26.4).

ATTENTION

Failure to correct the defects will result in the international application being considered withdrawn by this receiving Office (see Rule 26.5 for further details).

A copy of this invitation and any attachments has been sent to the International Bureau

☒ and the International Searching Authority

Name and mailing address of the receiving Office Assistant Commissioner for Patent, Box PCT Washington, D.C. 20231 Attn:RO/US Facsimile No. 703-305-3230	Authorized officer Melvin Brooks, Sr. Telephone No. (703) 305-5163
---	--

The receiving Office has found the following defects in the international application as filed:

1. As to signature* of the international application (Rules 4.15 and 90.4), the request:
- a. ☐ is not signed
 - b. ☒ is not signed by all the applicants
 - c. ☐ is not accompanied by the statement referred to in the check list in Box No. VIII of the request explaining the lack of the signature of an applicant for the designation of the United States of America
 - d. ☒ is signed by what appears to be an agent/common representative but:
 - ☒ the international application is not accompanied by a power of attorney appointing him
 - ☐ the power of attorney accompanying the international application was not signed by all the applicants
 - e. ☐ other (specify):

* All applicants must sign, including inventors if they are also applicants (e.g. where the United States of America is designated).

2. As to indications concerning the applicant, the request (Rules 4.4 and 4.5):

- a. ☐ does not properly indicate the applicant's name (specify):
- b. ☐ does not indicate the applicant's address
- c. ☐ does not properly indicate the applicant's address (specify):
- d. ☐ does not indicate the applicant's nationality
- e. ☐ does not indicate the applicant's residence
- f. ☐ other (specify):

3. As to the language of certain elements of the international application, other than the description and claims (Rules 12.1(c) and 26.3(a) and (c)):

- a. ☐ the request is not in a language of publication accepted by this receiving Office; (the) language(s) accepted by this receiving Office is/are:
- b. ☐ the text matter of the drawings is not in the language in which the international application is to be published, which is:
- c. ☐ the abstract is not in the language in which the international application is to be published, which is:

4. The title of the invention:

- a. ☐ is not indicated in Box No. I of the request (Rule 4.1(a))
- b. ☐ is not indicated at the top of the first sheet of the description (Rule 5.1(a))
- c. ☐ as appearing in Box No. I of the request is not identical with the title heading the description (Rule 5.1(a))

5. As to the abstract (Rule 8):

- ☐ the international application does not contain an abstract

IN THE UNITED STATES PATENT OFFICE (RO/US)

INTERNATIONAL APPLICATION NO.: PCT/US03/04749

INTERNATIONAL FILING DATE: 19 February 2003 (19.02.03)

PRIORITY DATE: 22 February 2002 (22.02.02)

APPLICANT: WAVE SEPARATION TECHNOLOGIES
LLC

ATTORNEY DOCKET NO.: 65641-0018

TITLE: METHOD AND APPARATUS FOR
SEPARATING METAL VALUES

Mail Stop PCT
Commissioner for Patents
P. O. Box 1450
Alexandria, Virginia 22313-1450

Attn: RO/US

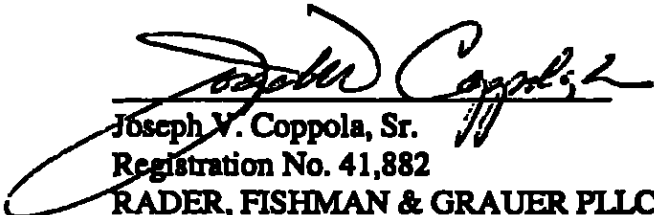
RESPONSE TO THE INVITATION TO CORRECT
DEFECTS IN THE INTERNATIONAL APPLICATION

In response to the INVITATION TO CORRECT DEFECTS IN THE
INTERNATIONAL APPLICATION mailed 03 April 2003, Applicant hereby submits a
Response to the Invitation to Correct Defects in the International Application.

Power of Attorney

Responsive to Annex A, enclosed are the executed Powers of Attorney (2) on behalf of Applicant and Applicant/Inventor. Applicant asks that these (2) Powers of Attorney be entered into the official record of this application.

Respectfully submitted,


Joseph V. Coppola, Sr.
Registration No. 41,882
RADER, FISHMAN & GRAUER PLLC
39533 Woodward Avenue
Suite 140
Bloomfield Hills, MI 48304
(248) 594-0600 (Telephone)
(248) 594-0610 (Facsimile)

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this paper or fee is being deposited with the U.S. Postal Service, postage prepaid, Express Mail Label No. EL78880744US, addressed to Mail Stop PCT, Commissioner for Patents, P. O. Box 1450, Alexandria, Virginia 22313-1450, on this 30th day of April, 2003.


Lee Paige Rhodes

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) (Names should be indicated as they appear in the request):

WAVE SEPARATION TECHNOLOGIES LLC
10 Talbot Court
Rexford, New York 12148

hereby appoints (appoint) the following person as:

☒ agent

☐ common representative

Name and address

(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

I hereby appoint the practitioners associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

COPPOLA, Sr., Joseph V.; BASCOBERT, Michael R.

Rader, Fishman & Grauer PLLC

39533 Woodward Avenue, Suite 140

Bloomfield Hills, Michigan 48304

US

Customer No. 010291

to represent the undersigned before

☒ all the competent International Authorities

☐ the International Searching Authority only

☐ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: METHOD AND APPARATUS FOR SEPARATING METAL VALUES

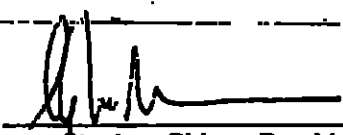
Applicant's or agent's file reference:

65641-0018

International application number (if already available):

filed with the following Office United States Patent and Trademark Office as receiving Office
and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) (where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):



Stephen Birken, President

Date:

2/20/2003

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCTRule90.4)

The undersigned applicant(s) (Names should be indicated as they appear in the request):

BIRKEN, Stephen
10 Talbot Court
Rexford, New York 12148

hereby appoints (appoint) the following person as:

☒ agent

☐ common representative

Name and address

(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

I hereby appoint the practitioners associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

COPPOLA, Sr., Joseph V.; BASCOBERT, Michael R.

Rader, Fishman & Grauer PLLC

39533 Woodward Avenue, Suite 140

Bloomfield Hills, Michigan 48304

US

Customer No. 010291

to represent the undersigned before

☒ all the competent International Authorities

☐ the International Searching Authority only

☐ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: METHOD AND APPARATUS FOR SEPARATING METAL VALUES

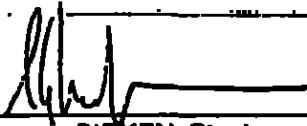
Applicant's or agent's file reference:

65641-0018

International application number (if already available):

filed with the following Office United States Patent and Trademark Office as receiving Office
and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) (where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):



BIRKEN, Stephen, Applicant/Inventor

Date:

2/20/2003

PATENT COOPERATION TREATY

32

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

COPPOLA, Joseph, V.
Rader, Fishman & Grauer PLLC
39533 Woodward Avenue
Suite 140
Bloomfield Hills, MI 48304
United States of America

Date of mailing (day/month/year) 28 April 2003 (28.04.03)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 65641-0018	
International application No. PCT/US03/04749	International filing date (day/month/year) 19 February 2003 (19.02.03)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 22 February 2002 (22.02.02)
Applicant WAVE SEPARATION TECHNOLOGIES LLC et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
22 Febr 2002 (22.02.02)	10/080,773	US	08 April 2003 (08.04.03)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740-1435	Authorized officer Sudha RAMAKRISHNAN Telephone No. (41-22) 338 8518
---	---

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

To:

COPPOLA, Joseph, V.
Rader, Fishman & Grauer PLLC
39533 Woodward Avenue
Suite 140
Bloomfield Hills, MI 48304
United States of America

Date of mailing (day/month/year) 28 April 2003 (28.04.03) ✓	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 65641-0018 ✓	International application No. PCT/US03/04749 ✓

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

WAVE SEPARATION TECHNOLOGIES LLC (for all designated States except US)
BIRKEN, Stephen (for US)

International filing date : 19 February 2003 (19.02.03)

Priority date(s) claimed : 22 February 2002 (22.02.02)

Date of receipt of the record copy
by the International Bureau : 08 April 2003 (08.04.03)

List of designated Offices :

AP : GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

EP : AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR

OA : BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG

National : AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ,
EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU,
LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT,
TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase - see updated important information (as of April 2002)
- ☒ confirmation of precautionary designations (if applicable)
- ☐ requirements regarding priority documents (if applicable)

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740-1435	Authorized officer: Sudha RAMAKRISHNAN Telephone No. (41-22) 338 8516
---	---

From the INTERNATIONAL BUREAU

PCTNOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

COPPOLA, Joseph, V.
Rader, Fishman & Grauer PLLC
39533 Woodward Avenue
Suite 140
Bloomfield Hills, MI 48304
ETATS-UNIS D'AMERIQUE

Date of mailing(day/month/year)

✓ 04 September 2003 (04.09.03)

Applicant's or agent's file reference

✓ 65641-0018

IMPORTANT NOTICE

International application No.

✓ PCT/US03/04749

International filing date(day/month/year)

19 February 2003 (19.02.03)

Priority date(day/month/year)

22 February 2002 (22.02.02)

Applicant

WAVE SEPARATION TECHNOLOGIES LLC

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this notice:

AU, AZ, BY, CH, CN, CO, DE, DZ, HU, JP, KG, KP, KR, MD, MK, MZ, RU, TM, US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE, AG, AL, AM, AP, AT, BA, BB, BG, BR, BZ, CA, CR, CU, CZ, DK, DM, EA, EC, EE, EP, ES, FI, GB, GD, GE, GH,
GM, HR, ID, IL, IN, IS, KE, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MG, MN, MW, MX, NO, NZ, OA, OM, PH, PL, PT, RO,
SD, SE, SG, SK, SL, TJ, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this notice is a copy of the international application as published by the International Bureau on
04 September 2003 (04.09.03) under No. 03/072835

4. **TIME LIMITS** for filing a demand for international preliminary examination and for entry into the national phase

The applicable time limit for entering the national phase will, subject to what is said in the following paragraph, be 30 MONTHS from the priority date, not only in respect of any elected Office if a demand for international preliminary examination is filed before the expiration of 19 months from the priority date, but also in respect of any designated Office, in the absence of filing of such demand, where Article 22(1) as modified with effect from 1 April 2002 applies in respect of that designated Office. For further details, see *PCT Gazette* No. 44/2001 of 1 November 2001, pages 19926, 19932 and 19934, as well as the *PCT Newsletter*, October and November 2001 and February 2002 issues.

In practice, time limits other than the 30-month time limit will continue to apply, for various periods of time, in respect of certain designated or elected Offices. For regular updates on the applicable time limits (20, 21, 30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at <http://www.wipo.int/pct/en/index.html>.

For filing a demand for international preliminary examination, see the *PCT Applicant's Guide*, Volume I/A, Chapter IX. Only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination (at present, all PCT Contracting States are bound by Chapter II).

It is the applicant's sole responsibility to monitor all these time limits.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Judith Zahra

Facsimile No.(41-22) 740.14.35

Telephone No.(41-22) 338.91.11

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PATENT

IN THE WORLD INTELLECTUAL PROPERTY ORGANIZATION (WO/IB)

Applicant: WAVE SEPARATION TECHNOLOGIES LLC
International Application No.: PCT/US03/04749
International Filing Date: 19 February 2003 (19.02.03)
Earliest Priority Claimed: 22 February 2002 (22.02.02)
Title of Invention: METHOD AND APPARATUS FOR
SEPARATING METAL VALUES
Attorney Docket No.: 209533-82360 (Formerly 65641-0018)

The World Intellectual Property Organization
34, chemin des Colombettes
1211 Geneva 20
Switzerland

VIA FACSIMILE

Attn: International Bureau

REQUEST FOR RECORDAL OF
CHANGE OF AGENT UNDER RULE 92bis

Applicant respectfully requests that the following change of agent be made of record in the above-identified international application.

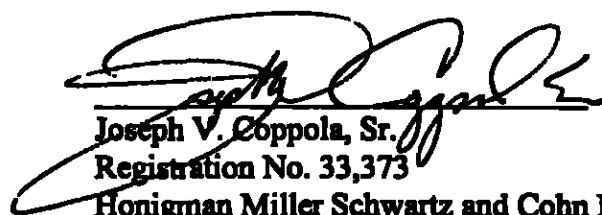
Please record the Agent of Record as follows:

Joseph V, Coppola, Sr., Esq.
Honigman Miller Schwartz and Cohn LLP
32270 Telegraph Road
Suite 225
Bingham Farms, Michigan 48025
Telephone No. (248) 566-8500
Facsimile No. (248) 566-8501

Applicant respectfully requests that the International Bureau act promptly to record this change.

Kindly acknowledge receipt of this transmission and our instructions via
facsimile.

Respectfully submitted,


Joseph V. Coppola, Sr.
Registration No. 33,373
Honigman Miller Schwartz and Cohn LLP
32270 Telegraph Road, Suite 225
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CERTIFICATE OF TRANSMISSION VIA FACSIMILE

I hereby certify that this paper is being transmitted via facsimile no. 011 41 22 740 1435 to the International Bureau of the World Intellectual Property Organization 34, chemin des Colombettes 1211 Geneva 20 on this 10th day of August, 2004.


Lee Paige Rhodes

PATENT COOPERATION TREATY

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PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

COPPOLA, Joseph, V.
Honigman Miller Schwartz and Cohn
LLP
32270 Telegraph Road
Suite 225
Bingham Farms, MI 48025
United States of America

Date of mailing (day/month/year)

16 August 2004 (16.08.2004)

Applicant's or agent's file reference

65641-0018 209533-F2360

IMPORTANT NOTIFICATION

International application No.

PCT/US2003/004749

International filing date (day/month/year)

19 February 2003 (19.02.2003)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address

COPPOLA, Joseph, V.
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State of Nationality

State of Residence

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248-594-0600

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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address

COPPOLA, Joseph, V.
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State of Nationality

State of Residence

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Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office ☒ the designated Offices concerned
☐ the International Searching Authority ☐ the elected Offices concerned
☐ the International Preliminary Examining Authority ☐ other:The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 338.70.90

Authorized officer

Sudha RAMAKRISHNAN

Telephone No. (41-22) 338 8518

MÉTODO Y APARATO PARA SEPARAR VALORES METÁLICOS

ANTECEDENTES DE LA INVENCION

CAMPO DE LA INVENCION

[001] La presente invención se relaciona con procesamiento mineral, y más particularmente, con un método y aparato para separar valores metálicos, tales como níquel y compuestos de níquel, de menas de minerales, incluyendo menas lateríticas.

DISCUSION

[002] El níquel es un elemento importante y es utilizado en una variedad de productos. este a menudo se combina con otros metales para formar acero inoxidable y aleaciones de acero, aleaciones no ferrosas y de alta temperatura. También se utiliza en electroplateo, catálisis, cerámicas y magnetos.

[003] Aunque el níquel se puede encontrar en muchos tipos diferentes de depósitos minerales, habitualmente

solamente las menas de sulfuro y lateríticas pueden ser explotadas como minas económicamente utilizando la tecnología existente. En las menas de sulfuro, el níquel, hierro y cobre comprenden una mezcla física de distintos minerales. Esto le permite a los productores concentrar el níquel presente en las menas de sulfuro utilizando técnicas mecánicas, tales como: flotación y separación magnética. Las menas lateríticas tienen una estructura significativamente diferente que las menas de sulfuro. Como resultado, los productores de níquel no pueden utilizar técnicas de separación mecánicas o físicas directas para concentrar el níquel en menas lateríticas sino en su lugar deben utilizar técnica de separación.

[004] Uno de los métodos químicos mas prometedores para obtener valores de níquel de menas lateríticas es llamada lixiviación ácida a alta presión. En el método minas lateríticas picadas y calibrada se ubican en un recipiente a presión con ácido sulfúrico. La mezcla es agitada a alta temperatura y alta presión (Por ejemplo, 280° C, 5.4 MPa) para lixiviar níquel y cobalto. La fase líquida resultante, que incluye níquel y cobalto disueltos, sufre un procesamiento adicional para separar el níquel y el cobalto.

[005] Aunque una tecnología útil, la lixiviación ácida a alta presión sufre de ciertas desventajas. Como se práctica habitualmente la lixiviación ácida alta presente es llevada a cabo en forma de tandas. En razón a que el níquel comprende solamente aproximadamente el 1% de la mena laterítica típica, el recipiente a presión debe ser cargado con grandes cantidades de mena, Por ejemplo, cien toneladas de mena para cumplir con los requisitos de producción diario. Esto da como resultado un gran gasto de capital para equipo. Comparada con las técnicas mecánicas, los costos de operación son altos porque la mezcla completa debe ser calentada a relativamente altas temperaturas para extraer una fracción significativa de níquel y cobalto de la fase sólida. Finalmente, el desecho del ácido sulfúrico gastado incrementa las preocupaciones ambientales.

[006] La presente invención soluciona, o al menos mitiga, uno o más de los problemas descritos anteriormente.

RESUMEN DE LA INVENCION

[007] La presente invención suministra métodos y aparatos para separar valores metálicos, tales como níquel y compuestos de níquel de menas minerales, incluyendo menas lateríticas. Los métodos de la invención utilizan procesos físicos para concentrar valores metálicos y por lo tanto no incrementen las preocupaciones ambientales asociadas con el procesamiento químico. Además, los métodos están adaptados a menas para proceso continuo que da como resultado unos gastos de capital inferiores que las operaciones de tanda. Finalmente, la invención descrita utiliza tecnología de microonda/onda de milímetro para calentar selectivamente los componentes de la mena, lo que ayuda a conservar los recursos de energía.

[008] Un aspecto de la invención suministra así un método para separar componentes de una mezcla de partículas, que está comprendida de la menos un primer grupo de partículas y un segundo grupo de partículas. Los miembros del grupo tienen composición química similar, aunque las partículas pertenezcan a diferentes grupos que tengan composiciones químicas no similares. El método .

también incluye exponer la mezcla de partículas a energía de microonda/onda de milímetro con el fin de calentar diferencialmente el primero y segundo grupo de partículas, incrementando así la diferencia en la susceptibilidad magnética entre el primero y el segundo grupo de partícula. Finalmente, el método comprende exponer la mezcla de partículas a través de un gradiente de campo magnético, lo que origina que las partículas se separen en primeras y segunda fracciones. Las primeras y segunda fracciones, respectivamente, mayores porcentajes de los primeros y segundos grupos de partículas que la mezcla.

[009] Un segundo aspecto de la invención suministra un método para concentrar valores de níquel de una mena laterítica. El método comprende suministrar una mena laterítica comprendida de una mezcla de partículas, y exponer la mena laterítica a energía de microonda/onda de milímetro con el fin de calentar selectivamente las partículas que contengan cantidad substanciales de valores de níquel. La exposición a la energía de microonda/onda de milímetro incrementa la diferencia en la susceptibilidad magnética entre las partículas que contiene cantidades de valores de níquel y la partículas .

que no. Adicionalmente, el método incluye exponer la mena laterítica a través de un gradiente de campo magnético, lo que origina que algunas de las partículas que contengan cantidades substanciales de valores de níquel se separa de las mezclas de partículas.

[0010] Un tercer aspecto de la invención suministra un aparato para separar componentes de una mezcla de partículas. El aparato incluye un recipiente que tiene un interior para contener la mezcla de partículas durante el procesamiento, y un sistema de energía acoplado al recipiente para exponer la mezcla de partículas a energía de microonda/onda de milímetro. El aparato también incluye un separador magnético que se comunica con el interior del recipiente. El separador magnético está adaptado para separar partículas magnéticas de partículas no magnéticas.

[0011] Un cuarto aspecto de la invención suministra un aparato para separar continuamente componentes de una mezcla de partículas. El aparato incluye un recipiente para contener la mezcla de partículas durante el procesamiento. El recipiente tiene un primer fin y un segundo fin y una entrada localizada adyacente al primer ,

extremo del recipiente que permite la entrada de partículas sólidas al recipiente. El aparato también incluye un distribuidor de gas que está dispuesto dentro del recipiente para fluidizar la mezcla de partículas, y un sistema de energía que está acoplado al recipiente para exponer la mezcla de partículas a energía de microonda/onda de milímetro. Finalmente, el aparato también incluye un separador magnético, que está localizado de manera adyacente al segundo extremo del recipiente y que se utiliza para separar partículas magnéticas de partículas no magnéticas.

BREVE DESCRIPCIÓN DE LOS DIBUJOS

[0012] La figura 1 es un diagrama de bloque que muestra el método para separar componentes de una mezcla de partículas.

[0013] La figura 2 es un diagrama de bloques que muestra un método de concentrar valores de níquel de una mena laterítica.

[0014] La figura 3 es una vista esquemática de un aparato para separar valores de metal, tales como níquel, de una mena mineral, que incluye una mena laterítica.

DESCRIPCIÓN DETALLADA

[0015] La figura 1 suministra un repaso de un método 10 para separar componentes de una mezcla de partículas. El método se fundamenta en calentar grupos de partículas a diferentes temperaturas utilizando energía de microonda/onda de milímetro, y luego explota los cambios en la susceptibilidad magnética entre las partículas - dando como resultado diferencia de temperaturas- para efectuar una separación magnética de los grupos de partículas. El método se puede utilizar para extraer valores metálicos de menas minerales que ordinariamente no son susceptibles de técnicas de separación física. Por ejemplo, y como se discute adelante, el método puede ser utilizado para concentrar valores de níquel de menas lateríticas sin las altas temperaturas, altas presiones, y condiciones ácidas rigurosas asociadas con la lixiviación ácida. A menos que sea claro del contexto de la discusión, los términos "níquel", "cobalto" y "hierro" o "valores de níquel", "valores de cobalto", y .

"valores de hierro", etc., se pueden referir, respectivamente, a átomos de níquel, cobalto hierro o a compuestos que contiene átomos de níquel, cobalto y hierro.

[0016] Como se muestra en la figura 1, el método 10 incluye suministrar 12 una mezcla de partículas en un alojamiento, recipiente o cavidad. La mezcla de partículas está comprendida de al menos un primer grupo partículas y un segundo grupo de partículas. Las partículas individuales que pertenecen a algún grupo particular - es decir, el primer grupo, el segundo grupo, etc., tiene una composición química similar, mientras que las partículas que pertenecen a diferentes grupos tienen composiciones químicas no similares. Así, por ejemplo, la mena laterítica picada y calibrada puede comprender un primer grupo de partículas que contengan predominantemente óxido de níquel, un segundo grupo de partículas que contengan predominantemente óxido de cobalto, un tercer grupo que contengan predominantemente óxido de hierro (FeO) y un cuarto grupo de partículas que contengan comparativamente tierra sin valor (ganga). Las partículas individuales de óxido de níquel, óxido de

cobalto u óxido de hierro pueden incluir ganga, así como porciones menores de otros óxidos metálicos.

[0017] Además de suministrar una mezcla de partículas, el método 10 también incluye exponer la mezcla la energía de microonda/onda de milímetro. En razón a que las sustancias no similares absorben generalmente la radiación de microonda/onda de milímetro en diferentes cantidades, exponer la mezcla de partículas la radiación de microonda/onda de milímetro, dará como resultado un calentamiento diferencial o selectivo de los grupos de partículas. Más aun, para muchas sustancias, incluyendo los materiales ferromagnéticos y antiferromagnéticos, la susceptibilidad magnética (es decir, el índice de la magnetización inducida a la intensidad de campo magnético) depende de la temperatura del material, Por ejemplo, u material ferromagnético perderá todas las propiedad magnéticas por encima de su temperatura Curie y un material antiferromagnético exhibirá máxima susceptibilidad magnética en su temperatura Néel. El óxido de níquel, Por ejemplo, debe exhibir su máxima susceptibilidad magnética en su temperatura Néel, que varía desde aproximadamente 260° C a aproximadamente 377°

C, y el FeO debe exhibir máxima susceptibilidad magnética en su temperatura Néel que es aproximadamente -75° C.

[0018] Como se anotó anteriormente. El método 10 mostrado en la figura 1 utiliza cambios en la susceptibilidad magnética entre las partículas para separar los grupos de partículas. Así, el método 10 incluye exponer la mezcla de partículas a un gradiente de campo magnético, lo que origina que las partículas se separen en primeras y segundas fracciones. Las primeras y segundas fracciones están comprendidas principalmente de primeros y segundos grupos de partículas respectivamente. Así, Por ejemplo, el primer grupo de partículas puede comprender partículas de óxido de níquel, que han sido selectivamente calentadas hasta aproximadamente su temperatura Néel. El segundo grupo de partículas puede comprender ganga (Por ejemplo dióxido de silicio) y similares que han sido calentadas a una proporción inferior. Cuando la mezcla de partículas es expuesta al gradiente de campo magnético, las partículas de óxido de níquel tienden a alinearse ellas mismas con las líneas de fuerza que comprenden el gradiente de campo magnético, mientras que las partículas diferentes a níquel permanecen relativamente sin afectarse por el .

gradiente de campo magnético. En razón a que las partículas de óxido de níquel siguen las líneas de la fuerza magnética el método 10 despoja las partículas de óxido de níquel de la dirección de flujo primario de la mezcla de partículas.

[0019] La separación efectiva dependerá de muchos factores, incluyendo la distribución por tamaño de la mezcla de partículas, las diferencias en la susceptibilidad magnética entre los grupos de partículas, la intensidad del gradiente de campo magnético aplicado, y así sucesivamente. Dependiendo de el tipo de separador magnético utilizado, los tamaños de partícula del material base (Por ejemplo la mena de mineral) usualmente varían desde aproximadamente 10^{-1} micrómetros a aproximadamente 10^4 micrómetros. Para los separadores magnéticos de alto gradiente, que pueden aplicar gradiente de campo magnético hasta de aproximadamente 25×10^6 G/cm, los tamaños de partículas del material base típicamente caen dentro de la porción inferior del rango de tamaño de partícula - es decir, desde aproximadamente 10^{-1} a aproximadamente 10^2 micrómetros. Para otros tipos de separadores magnéticos secos, que pueden aplicar gradientes de campo magnético entre aproximadamente 10^2 .

G/cm y 10^5 G/cm, los tamaños de partículas del material base ordinariamente caen dentro de la porción superior del rango de tamaño de partícula.

[0020] En muchos casos, solamente uno de los grupos de partículas exhibirá susceptibilidad magnética medible luego de la exposición a la energía de microonda/onda de milímetro y ese grupo será el componente valioso. En otros casos, el componente valioso puede exhibir susceptibilidad magnética despreciable, aunque el resto de las partículas sean magnéticas. En casos cuando dos o más grupos de partículas exhiben sustancialmente magnética, y solamente uno de los grupos de partículas es de interés la exposición a microonda/onda de milímetro se puede ajustar para maximizar la diferencias en la susceptibilidad magnética entre las partículas de interés y las otras partículas de la mezcla. La razón a que la magnitud de la susceptibilidad magnética de un material a su temperatura Néel es generalmente más débil que un material ferromagnético por debajo de su temperatura Curie, el método 10 a menudo emplea un separador magnético de alto gradiente.

[0021] El método 10 puede incluir otras etapas opcionales. Por ejemplo, el método 10 puede incluir poner en contacto la mezcla de partículas con un gas inerte o reactivo. Tal contacto puede ser deseable por muchas razones. Por ejemplo, el método 10 puede emplear un gas para fluidizar las partículas, que como se describe adelante, ayuda a transportar la mezcla de partículas a través del equipo de proceso. Alternativa o adicionalmente, el método 10 puede utilizar un gas para pelar impurezas de las partículas sólidas, para formar productos de reacción deseados, y similares.

[0022] Regresando ahora a una aplicación por ejemplo, la figura 2 ilustra un método 100 para concentrar valores de níquel de una mena laterítica. Se debe notar, sin embargo, que con la modificación adecuada del método 100 se podía utilizar para concentrar muchos diferentes valores metálicos de una variedad de menas minerales. Como se mostró en la figura 2, el método 100 incluye suministrar 102 una mena laterítica comprendida de una mezcla de partículas. Esta etapa puede comprender una variedad de tareas, incluyendo la extracción de mena laterítica de la tierra, el transporte y almacenamiento de la mena mineral, y similar. Además, en razón a que la,

separación magnética efectiva requiere que el componente o los componentes de interés comprendan partículas discretas, la etapa de suministro puede incluir liberar el componente de interés de la matriz de la mena - aquí, óxido de níquel- al picar, moler (si es necesario), y calibrar (Por ejemplo tamizar) las partículas de la mena.

[0023] Después de las partículas son picadas y molidas al tamaño de requisito, lo cual para una mena laterítica típica es menos de aproximadamente malla 20 o aproximadamente 1,3 mm, la mena es expuesta 104 a energía de microonda/onda de milímetro con el fin de calentar selectivamente las partículas que contenían cantidades sustanciales de valores de níquel. Al calentar selectivamente las partículas de óxido de níquel, el método 100 incrementa la diferencia en la susceptibilidad magnética entre las partículas que cotejan cantidades sustanciales de valores de níquel y partículas que no. Para el óxido de níquel, esto corresponde a calentar las partículas a su temperatura Néel, lo cual está entre aproximadamente 260° C y 377° C. Se debe entender que las partículas de óxido de níquel podían ser calentadas a temperaturas diferentes que la temperatura Néel (Por

ejemplo entre 150° C y 300° C) en tanto que ellas logren el nivel deseado de susceptibilidad magnética.

[0024] El método 100 también incluye exponer 106 la mena laterítica a un gradiente de campo magnético, lo cual origina al menos que algunas de las partículas que contengan cantidades sustanciales de valores de níquel se separen de la mezcla de partículas. Además de los valores de níquel, las menas lateríticas generalmente contienen otros valores de metal, las cuales probablemente han sido selectivamente calentadas a una temperatura diferente que sus temperaturas Néel. Estas partículas pueden retener susceptibilidad magnética residual de tal forma que durante la etapa de separación magnética, algunas de ellas podrían ser atrapadas por las partículas de óxido de níquel. Los valores de níquel concentrados resultantes y quizás una pequeña fracción de los valores de metálicos atrapados pueden sufrir procesamiento adicional (refinación, fundición, etc.) o se pueden vender como un producto terminado.

[0025] La figura 3 muestra un aparato 200 que se puede utilizar para llevar a cabo los procesos 10, 100 mostrados en la figura 1 y figura 2 respectivamente. El ,

aparato 200 comprende un recipiente 202, que contiene la mezcla de partículas (Por ejemplo mena picada y calibrada) durante el procesamiento. Como se indica por las flechas 204, 206, la mezcla de partículas y un gas (típicamente aire comprimido, que se puede enfriar o calentar) entra al recipiente 202 por vía de los puertos 208, 210 en un primer extremo 212 del recipiente 202. el gas se descarga a un plenum 214 y fluye hacia arriba a través de un distribuidor de gas 216 (es decir un plato enrejado o perforado) que alcanza la distancia entre los lados y el primer extremo 212 y el segundo extremo 218 del recipiente 202.

[0026] Las partículas sólidas que son mostradas esquemáticamente como círculos 220 de la figura 3, viajan desde el primer extremo 212 al segundo extremo 218 del recipiente 202 a lo largo del distribuidor de gas 216. para ayudar a transportar las partículas sólidas 220 entre los extremos 212, 218 del recipiente 202, el flujo as que fluye hacia arriba del distribuidor 216 levanta la partículas 220 produciendo un lecho fluidizado 222 que se comporta de una manera similar a un líquido. El gas utilizado para fluidizar las partículas 220, fluye dentro el espacio de desacoplamiento 224 y sale del recipiente .

202 por vía de un puerto 226. Un conducto 228 canaliza el gas hacia dentro del separador de polvo 230 (Por ejemplo un ciclón) que remueve cualquier sólido atrapado 232 de la corriente de gas 234. Además de actuar como medio fluidizante el gas puede pelar impurezas suministrar una superficie de recubrimiento, reaccionar para formar un producto deseado, y así sucesivamente.

[0027] El aparato 200 incluye un sistema de energía 236, que se puede utilizar las partículas 220 a energía de microonda/onda de milímetro por vía de técnicas radioactivas. El sistema 236 incluye una fuente 238 de energía de microonda/onda de milímetro y un aplicador 240, que está dispuesto dentro del recipiente 202. El sistema 236 también incluye una guía de onda 242, que dirige la energía de microonda/onda de milímetro desde la fuente 238 al aplicador 240. Como se utiliza en esta descripción, la energía de microonda/onda de milímetro se refiere a frecuencias que tienen energía tan baja como 100 MHz hasta tan alta como 3000 GHz. Para una discusión de sistemas útiles para generar y aplicar energía de microonda/onda de milímetro para procesar materiales, ver la patente U.S. No. 4,894,134; 5,784,682; y 6,090,350,

que se incorpora aquí como referencia en su totalidad para todos los propósitos.

[0028] Como se puede ver en la figura 3, después de que las partículas 220 han sido calentadas diferencialmente a través de la exposición a energía de microonda/onda de milímetro desde el aplicador 240, ellas alcanzan un segundo extremo 218 del recipiente 202 donde ellas pasan a través de un separador magnético 244. Como se indicó por las flechas 246, 248, el separador magnético separa las partículas magnéticas 250 (es decir aquellas que tiene una susceptibilidad magnética de umbral) de las partículas no magnéticas concentrando de esta manera las partículas magnéticas (o las partículas no magnéticas). Como se anotó anteriormente, los separadores magnéticos de alto gradiente son específicamente útiles, pero dependiendo de la susceptibilidad magnética de las partículas magnéticas 250, se puede utilizar otros dispositivos. Para una discusión de los separadores magnéticos útiles, ver Robert H. Perry y Don W. Green, "Perry's Chemical Engineer's Handbook". Pp. 19-40 a 19-49 (séptima Ed. 1997).

[0029] Aunque el aparato 200 mostrado en la figura 3 utiliza un lecho fluidizado 222 para transportar partículas individuales 220 entre los extremos 212, 218 del recipiente 202, se pueden utilizar otros dispositivos. Por ejemplo, Algunas modalidades pueden utilizar correas, que se pueden acoplar a una polea magnética en el segundo extremo 218 del recipiente 202 para llevar a cabo la separación magnética. Otras modalidades pueden basarse en la gravedad para transportar partículas y pueden incluir un sistema de distribución de gas para poner en contacto las partículas con un gas inerte o reactivo para pelar las impurezas de las partículas, formar productos de reacción deseados, modificar las propiedades de superficie de las partículas, y similares. El aparato 200 mostrado en la figura 3 se adapta a mezclas de proceso continuo de partículas, lo que minimiza el tamaño de requisito del recipiente 202 y de esta manera los gastos de capital. Sin embargo, se pueden utilizar otros aparatos que operan en forma de tanda o semitanda, que probablemente darían como resultado un capital mayo y costos de labor, pero pueden dar como resultado una mayor recuperación de material de interés.

[0030] Otras modalidades pueden canalizar las partículas magnéticas 250 hacia dentro del segundo recipiente (no mostrado) donde las partículas 250 sufre de tratamiento adicional. Como el aparato 200 mostrado en la figura 3 puede incluir las estructuras necesaria para calentar las partículas 250 (Por ejemplo fuente de microonda/onda de milímetro) y para poner en contacto las partículas 250 con un gas inerte o reactivo (Por ejemplo un distribuidor de gas). Tal aparato podría emplear un gas que puede ser igual o diferente que cualquier gas fluidizante utilizado, y que incluye azufre (Por ejemplo sulfuro de hidrógeno) con el fin de convertir óxido de níquel a sulfuro de níquel.

[0031] Se debe entender que la descripción anterior pretende ser ilustrativa y no limitativa. Muchas modalidades serán evidentes para aquellos expertos en la técnica luego de leer la anterior descripción. Por la tanto, el alcanza de la invención se debe determinar, no con referencia a la anterior descripción, sino en su lugar con referencia a las reivindicaciones finales, junto con el alcance completo de los equivalentes a las que tiene derecho tales reivindicaciones. La descripción de todas las patentes, artículos y referencias, .

incluyendo la solicitud desde patente y publicaciones, si existe alguna, se incorporan aquí como referencia en su totalidad para todos sus propósitos.

REIVINDICACIONES

1. Un método para separa componentes de una mezcla, el método comprende:

Suministrar una mezcla de partículas, la mezcla comprende al menos un primer grupo de partículas y un segundo grupo de partículas, el primer grupo de partículas tiene una composición química diferente del segundo grupo de partículas;

Exponer la mezcla de partículas a energía de microonda/onda de milímetro con el fin de calentar diferencialmente el primer grupo y el segundo grupo de partículas, incrementando de esta manera la diferencia de la susceptibilidad magnética entre el primero y el segundo grupo de partículas;

Exponer la mezcla de partículas a un gradiente de campo magnético, el gradiente de campo magnético origina que las partículas se separen en primeras y segundas fracciones, la primer fracción tiene un porcentaje mayor del primer grupo de partículas que la mezcla, y la segunda fracción tiene un mayor porcentaje del segundo grupo de partículas que la mezcla.

2. El método de la reivindicación 1, en donde la mezcla de partículas es una mena laterítica.
3. El método de la reivindicación 1, en donde el primer grupo de partículas incluye uno o más valores de metal.
4. El método de la reivindicación 3, en donde exponer la mezcla de partículas a energía de microonda/onda de milímetro comprende además calentar al menos una porción del primer grupo de partículas a aproximadamente la temperatura Néel de uno de los valores metálicos.
5. El método de la reivindicación 3, en donde el primer grupo de partículas incluye uno o más valores de níquel.
6. El método de la reivindicación 1, que comprende además un tercer grupo de partículas que incluye uno o más valores de cobalto.

7. El método de la reivindicación 1, que comprende además poner en contacto la mezcla de partículas con un gas.
8. El método de la reivindicación 1, que comprende además fluidizar la mezcla de partículas.
9. Un método para concentrar valores de níquel de una mena laterítica, el método comprende:
Suministrar una mena laterítica comprendida de una mezcla de partículas;
Exponer la mena laterítica a energía de microonda/onda de milímetro con el fin de calentar selectivamente las partículas que contengan cantidades sustanciales de uno o mas valores de níquel, incrementando de esta manera la diferencia en la susceptibilidad magnética entre las partículas que contengan cantidades sustanciales de valores de níquel y partículas que contengan cantidades insustanciales de valores de níquel,
Exponer la mena laterítica a un gradiente de campo magnético, originando al menos que alguna de las partículas que contenga cantidades sustanciales de

valores de níquel se separen de la mezcla de partículas.

10. El método de la reivindicación 9, en donde los valores de níquel son óxidos de níquel.
11. El método de la reivindicación 9, en donde exponer la mezcla de partículas a energía de microonda/onda de milímetro comprende además calentar al menos una porción de las partículas que contienen cantidades sustancial de valores de níquel a aproximadamente la temperatura Néel de uno de los valores metálicos.
12. El método de la reivindicación 9, en donde exponer la mezcla de partículas a energía de microonda/onda de milímetro comprende además calentar al menos una porción de las partículas que contiene cantidades sustanciales de valores de níquel a una temperatura de al menos aproximadamente 150° C.
13. El método de la reivindicación 9, en donde exponer la mezcla de partículas a energía de microonda/onda de milímetro comprende además calentar al menos una porción de las partículas que contiene cantidades .

sustanciales de valores de níquel a una temperatura de al menos aproximadamente 250° C.

14. El método de la reivindicación 9, que comprende además poner en contacto la mezcla de partículas con un gas.

15. El método de la reivindicación 9, que comprende además fluidizar la mezcla de partículas.

16. Un aparato para separar componentes de una mezcla de partículas, el aparato comprende:

Un recipiente que tiene un interior para contener una mezcla de partículas durante el procesamiento;

Un sistema de energía acoplado al recipiente para disponer la mezcla de partículas a energía de microonda/onda de milímetro; y

Un separador magnético que comunica con el interior del recipiente para separar partículas magnéticas de partículas no magnéticas.

17. El aparato de la reivindicación 16, que comprende además un distribuidor de gas para poner en contacto la mezcla de partículas con un gas.
18. El aparato de la reivindicación 16, que comprende además un distribuidor de gas para fluidizar la mezcla de partículas
19. El aparato de la reivindicación 16, que comprende además un segundo recipiente que tiene un interior en comunicación con un separador magnético.
20. El aparato de la reivindicación 19, que comprende además un distribuidor de gas para poner en contacto las partículas contenidas en el interior del segundo recipiente con un gas aparte.
21. El aparato de la reivindicación 20, que comprende adicionalmente una fuente de gas en comunicación fluida con el distribuidor de gas, en donde la fuente de gas incluye azufre o un compuesto que contiene azufre.

22. El aparato de la reivindicación 19, que comprende además un distribuidor de gas para fluidizar las partículas contenidas en el interior del segundo recipiente.

23. Un aparato para separar componentes de una mezcla de partículas, el aparato comprende:

Un recipiente para contener la mezcla de partículas durante el procesamiento, el recipiente tiene un primer extremo y un segundo extremo y una entrada localizada adyacente al primer extremo del recipiente que permite la entrada de las partículas sólidas dentro del recipiente;

Un distribuidor de gas dispuesto dentro del recipiente para fluidizar la mezcla de partículas;

Un sistema de energía acoplado al recipiente para exponer la mezcla de partículas a energía de microonda/onda de milímetro; y

Un separador magnético localizado adyacente al segundo extremo del recipiente para separar partículas magnéticas de partículas no magnéticas.

MÉTODO Y APARATO PARA SEPARAR VALORES METÁLICOS

RESUMEN

Se escriben métodos y aparatos para separar valores metálicos, tales como níquel y compuestos de níquel, de menas minerales que incluyen menas lateríticas. El método incluye suministrar una mezcla de partículas (Por ejemplo, mena picada y calibrada) que está compuesta de al menos un primer grupo de partículas y un segundo grupo de partículas. Los miembros del grupo tienen composición química similar, aunque las partículas pertenezcan a diferentes grupos que tengan composiciones químicas no similares. La mezcla de partículas es expuesta a energía de microonda/onda de milímetro con el fin de calentar diferencialmente el primero y el segundo grupo de partículas, incrementando de esta manera las diferencias en la susceptibilidad magnética entre el primero y segundo grupo de partículas. La mezcla de partículas es luego pasada a través de un gradiente de campo magnético, lo que origina que las partículas se separen en fracciones magnéticas y no magnéticas.

FIGURA 1

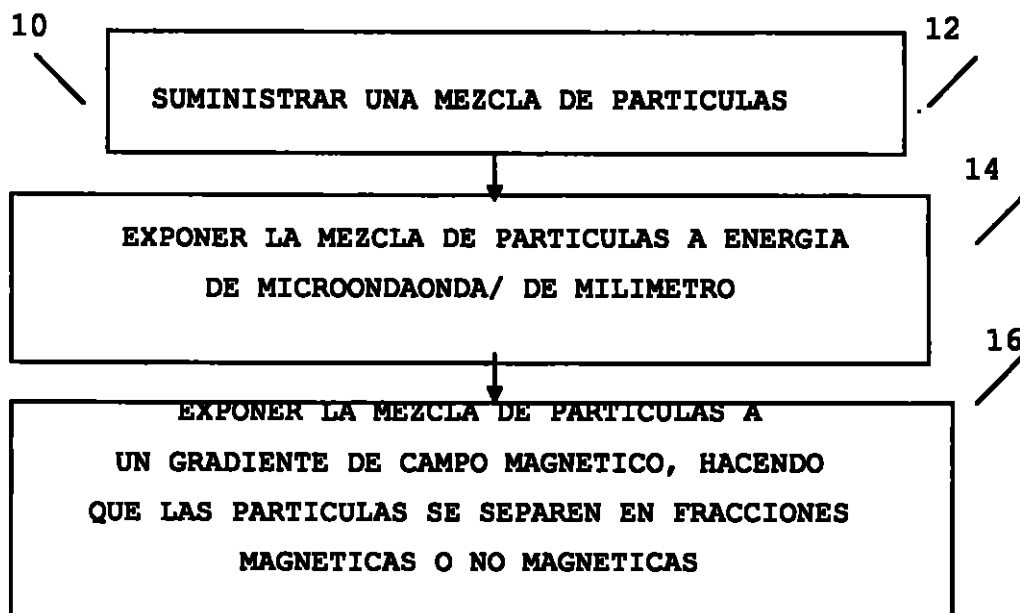
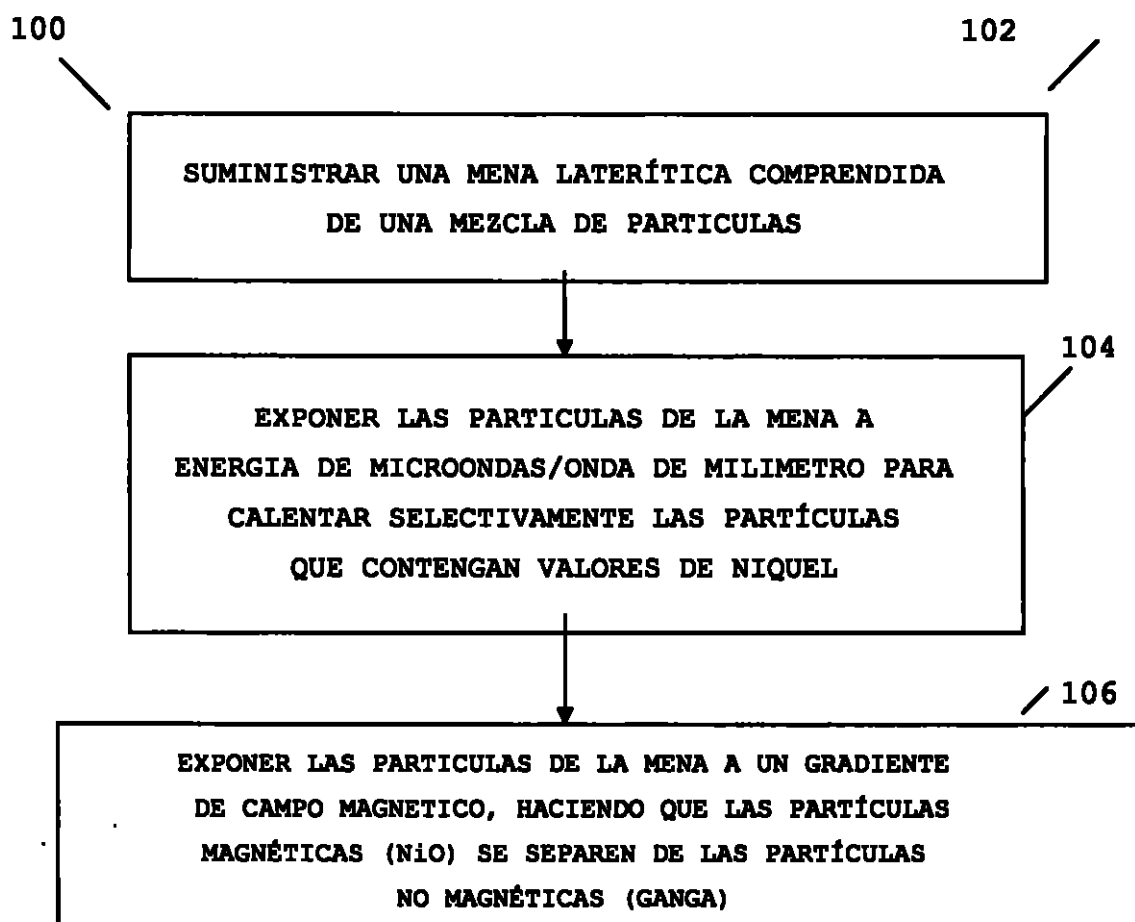


FIGURA 2



NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 04 - 72,676
FECHA : SEPTIEMBRE 13 DE 2004

SUPERINDUSTRIA Y COMERCIO
Radicacion : 04033823 00000000 Folios: 69
Fecha (MM): 2004-09-21 17:21:56
Tramite : 011 PCT-PATENT 378 FASE NACI 411 PRESENTAC
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
CAVELIER ABOBADOS	CONSIGNACION	BANCO POPULAR	030-00110-6	32738682	13/09/2004	27,013,000.00

***** C O N C E P T O *****

CANT. RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1 30005-01-01 SOLICITUDES	1 TRAMITES DE SOL. DE PATENTE DE IN	422,000.00
	TOTAL :	\$ 422,000.00

SON: CUATROCIENTOS VEINTIDOS MIL PESOS

RESPONSABLE : 

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

0610 14486-841-001-6

50 70

SUPERINDUSTRIA Y COMERCIO
Radicacion : 04093028 00000000 Folios: 69
Fecha (MM): 2004-09-21 17:21:56
Tramite : 011 PCT-PATENT 370 FASE NACI 411 PRESENTAC
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

REQUISITOS NECESARIOS PARA PRESENTACION Y AGILIZACION DEL TRAMITE

USUARIO RADICADOR

PATENTE DE INVENCION

MODELO DE UTILIDAD

- Indicación de que se solicita la concesión de una patente.
- Datos de identificación del solicitante o de la persona que se presenta la solicitud.
- Descripción de la invención.
- Dibujos de partes pertinentes.
- Comprobante de Pago de las tasas establecidas.

COMPLETA

INCOMPLETA

DISEÑO INDUSTRIAL

- Indicación de que se solicita el registro de Diseño Industrial
- Datos de identificación del solicitante o de la persona que presenta la solicitud.
- Representación gráfica o fotográfica del Diseño Industrial o muestra del Material que incorpora el diseño.
- Comprobante de pago de las tasas establecidas

COMPLETA

INCOMPLETA

ESQUEMA DE TRAZADO

- Indicación de que solicita el registro de un Esquema de trazado.
- Datos de identificación del solicitante o de la persona que presenta la solicitud.
- Representación gráfica del esquema de trazado
- Comprobante de pago de las tasas establecidas.

COMPLETA

INCOMPLETA

Firma Responsable:

Chusca M Nava

Fecha:

2020
Bogotá, D.C.,

Doctor:
EMILIO FERRERO

Oficio N° 10041

ASUNTO:	Radicación N°	04-93828
	Solicitud internacional	PCT/US03/04749
	Fecha inicio fase nacional	22/09/2004
	Trámite	011
	Evento	379
	Actuación	416
	Folios	001

Como resultado del examen de forma, realizado con fundamento en el artículo 38 de la Decisión 486 de la Comisión de la Comunidad Andina, artículo 27 del Tratado de Cooperación en Materia de Patentes (PCT), regla 51 bis del Reglamento y Circular Única de la Superintendencia de Industria y Comercio, se le comunica que:

- La solicitud no contiene la copia del documento en que consta la cesión del derecho a la patente del inventor al solicitante o a su causante. (Art. 26-k) Decisión 486).
- La solicitud no contiene el poder debidamente otorgado, con el lleno de los requisitos exigidos por los artículos 63 y subsiguientes del Código de Procedimiento Civil. Adicionalmente, deberá presentar el documento que acredita la existencia y representación legal de la sociedad solicitante, cuando ésta fuere persona jurídica.

En cumplimiento de lo dispuesto por el artículo 39 de la Decisión 486, se le requiere para que dentro del término de dos meses siguientes a la fecha de notificación del presente oficio, complete los requisitos anteriormente enunciados. En caso de no dar cumplimiento al presente requerimiento, la solicitud se considerará abandonada y perderá su prelación.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.


ALIX CARMENZA CESPEDES DE VERGEL
Jefe de la División de Nuevas Creaciones.

El anterior requerimiento fue notificado por fijación en lista de fecha, 29 OCT. 2004.