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(54) Benævnelse: **FREMGANGSMÅDE OG APPARAT TIL STYRING AF EN FLOTATIONSSEPARATIONSPROCES, INKLUSIV PARAMETRE AF FLOTATIONSPROCESSEN OG REAGENSTILSÆTNING TIL OPTIMERING AF MINERALGENVINDING**

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DESCRIPTION

BACKGROUND OF THE INVENTION

1. Field of Invention

[0001] This invention relates to a flotation process, e.g., such as a flotation separation process used in a mineral extraction processing system; and more particularly to a technique for controlling such a flotation separation process.

2. Description of Related Art

[0002] In many industrial processes, a flotation separation process is used to concentrate and clean the final product. A minerals processing plant, or beneficiation plant, is no exception. In the case of a copper concentrator as shown in Figure 1a, the input to the plant is water and ore (of a particular type and size distribution) and the outputs are copper concentrate and tailings. The processes consist of grinding, classification, flotation and thickening stages, as shown in Figure 1b. The grinding and classification stages produce a fine slurry of water, ore and chemicals which is then sent to the flotation stage. Once in the flotation stage, air and chemical reagents are used to float the copper minerals, while gange (tailings) is depressed. The recovered copper is cleaned and dried. The tailings are thickened and sent to a tailings pond.

[0003] In the flotation stage, the bubbles are introduced to the slurry to carry (float) the desired ore content to the top of the flotation cell, while the tailings are depressed and flow to the bottom of the cell. The performance of the flotation stage is dependent on many parameters. One of those is the floatability of the ore. The floatability is highly dependent on the type and doses of chemical reagents that are used to make the desired particles of ore hydrophobic. The chemical dosing rate is typically defined in units of grams of chemical per ton or ore processed. In some cases, more chemical is added than is necessary in order to make sure that enough is being used. These chemicals are very expensive and make up a sizable portion of a mineral processing plant's operational expenses.

[0004] Another factor in the performance of the flotation stage is the size of the bubbles, the overall amount of bubbles, and the rate or speed that the bubbles move / rise through the flotation cell. These bubbles create a layer of froth at the top of the flotation cell. The characteristics of the froth, such as the depth of the froth layer, its composition and its stability, also impact the performance of the flotation stage.

[0005] In a typical plant, operators will determine the ore tonnage rate by using a weight scale on the input ore feed to the first stage of grind. Then the reagent is added according to the prescribed dosing rate. It would be possible to optimize the addition of reagent and other control parameter, such as the addition of air and feed rate and density of the ore, to optimize the recovery of ore in the flotation stage.

[0006] WO 2008/061289 A1 discloses techniques for monitoring a froth phase of a liquid system, e.g. by detecting acoustic emissions in an ultrasonic frequency range using sensors located within the froth phase and analyzing the acoustic emissions. The analysis includes digitally processing and filtering acoustic emissions signals to calculate RMS values, and further processes the same. The techniques include adjusting an operating parameter of the liquid system based upon the analysis.

[0007] Vanegas C et al., "On-line froth acoustic emission measurements in industrial sites", Minerals Engineering, Pergamon Press, Oxford, GB, vol. 21, no. 12-14, 1 November 2008, pages 883-888 discloses techniques for determining an optimum range of froth stability in a flotation cell by using ultrasonic sensors to measure elastic energy released by film rupture during bubble coalescence in the flotation cell, based upon the fact that when bubbles coalesce their junction film ruptures, producing an instantaneous and short oscillation in acoustic pressure mainly concentrated in an audible frequency range. Based upon the fact that coalescence events last about 20 milliseconds, disclosed techniques uses sensors to detect ultrasonic frequencies caused by the bubble coalescence, while at the same time isolating environmental noise concentrated at lower frequencies.

[0008] WO 2005/098377 A1 discloses techniques for monitoring and controlling foaming by detecting when acoustic emissions exceed a threshold level and providing response signaling for activating a foam suppressant, sounding an audible alarm, dialing a telephone, etc. The passive acoustic sensors include hydrophone(s) positioned above and/or below the foam surface.

[0009] DE 10 2006 038 208 A1 relates to a method for controlling an operational parameter of a flotation cell that comprises a housing and that is used to separate amounts of solid particles in a suspension. The individual sound signal of the flotation cell that is produced during operation is received in the flotation cell, a characteristic characterizing the operational parameter is extracted from the received individual sound signal, and an adjustable variable for controlling the operational parameter is determined from the extracted characterized characteristic.

[0010] US 7,426,852 discloses a closed loop control system for mineral processing, based on using a submersible meter. In operation, pressure sensors in the submersible meter respond to unsteady pressure produced by acoustical and vortical disturbances in the fluid having a froth layer, and provide signaling containing information about the same along conduit to a transmitter. The transmitter processes the signaling received and provides four characteristics/ parameters including speed of sound, gas holdup, volume flow rate and flow rate. In addition, a controller in the control system responds to signals from the transmitter, as well as flow measurements from flow meters, and a user control input, and controls motors, pumps and valves to control the speed of a mixer in a tank, the gas flow rate, slurry flow rate, overflow rate, tailings flow rate, wash water and chemical additions (e.g., frother, reagent PH control and water), in order to operate the mineral processing.

[0011] The present invention relates to an apparatus and method according to the appended claims. It provides a new and unique method and apparatus suitable to control of a flotation separation process, including parameters of the flotation process and reagent addition to optimize mineral recovery.

[0012] According to some embodiments of the present invention, the signal processor or processing module may also be configured to provide the corresponding signalling to control the flotation separation process based at least partly on the control characteristic determined.

[0013] Acoustic sensing may be used to monitor acoustic characteristics of the froth layer in the flotation cell or tank, e.g., to thereby maximize the recovery of ore. By way of example, the acoustic characteristics of the froth layer may then be used to control, e.g., reagent dosing, ore feed rate, ore feed density, froth depth, superficial gas velocity or other aspects of the flotation cell to maximize ore recovery.

[0014] The acoustic characteristics of the ore may be monitored by using at least one acoustic detection means or device, such as for example a microphone. The acoustic detection means or device may be placed above the froth layer, directly in or near the froth layer, or below the froth layer.

[0015] The at least one acoustic detection means or device may be placed below the froth layer, and the acoustic detection means may monitor the acoustics of the froth cell reflected at the interface between the froth layer and the layer below, known as the pulp zone, due to the difference in acoustic impedance between the froth layer and the pulp zone.

[0016] According to some embodiments of the present invention, two or more acoustic detection means or devices may be placed above and below the froth layer, in and below the froth layer, or entirely within the froth layer, and the acoustic detection means or devices may monitor the attenuation through the froth layer, between the froth layer and the pulp zone, between the froth layer and the air above the froth layer, or any combination.

[0017] According to some embodiments of the present invention, acoustic detection sensors may be mounted external to the flotation cell. In this embodiment, an acoustic guide may be placed within the tank to optimize the acquisition of the acoustic signal. For example, an acoustic waveguide may be placed within the flotation cell or tank such that the waveguide interacts with the tank solution and gas bubbles, and separate acoustic detection means are mounted on the exterior of the tank to acquire the acoustic signal from the waveguide.

[0018] According to some embodiments of the present invention, the acoustic detection means or devices may be positioned at a number of locations, such as above, within, and/or below the froth layer to monitor the acoustic characteristics of the froth layer.

[0019] According to some embodiments of the present invention, the at least one acoustic detection means or device may also be used to monitor the acoustic characteristics of the bubbles in the pulp zone to control the flotation cell, e.g., to optimize ore recovery.

[0020] According to some embodiments of the present invention, the acoustic detection methods disclosed herein may be augmented with acoustic sources place in, under, next to or above the froth layer.

[0021] By way of example, the signal processor or processor module may take the form of a processor and at least one memory including a computer program code, where the processor and at least one memory are configured to cause the apparatus to implement the functionality of the present invention, e.g., receive the signalling containing information about at least one acoustic characteristic of the froth layer in the flotation cell or tank of the flotation separation process; and determine the control characteristic related to the flotation separation process based at least partly on the signalling received. The processor and the at least one memory including the computer program code may also include one or more of the various features set forth above.

[0022] According to some embodiments, an apparatus may also take the form of a computer-readable storage medium having computer-executable components for performing the steps of the aforementioned method. The computer-readable storage medium may also include, or be configured to perform, steps for implementing one or more of the various features set forth above.

BRIEF DESCRIPTION OF THE DRAWING

[0023] The drawing includes Figures 1 - 4, which may not be drawn to scale, as follows:

Figure 1a is a block diagram of a mineral extraction processing system in the form of a copper concentrator that is known in the art.

Figure 1b is a block diagram showing typical processing stages of a mineral extraction processing system that is known in the art.

Figure 2 is a block diagram of apparatus according to some embodiments of the present invention.

Figure 3 is a diagram of the apparatus shown in Figure 2 arranged in relation to a flotation cell or tank according to some embodiments of the present invention.

Figure 4 is a block diagram of a method having steps for implementing a flotation separation process according to some embodiments of the present invention.

DETAILED DESCRIPTION OF BEST MODE OF THE INVENTION

[0024] Figure 2 shows the present invention in the form of apparatus 10 configured to control of a flotation separation process, including parameters of the flotation process and reagent addition to optimize mineral recovery. By way of example, Figure 3 shows at least part of the flotation separation process, which, e.g., may be configured to form part of the mineral extraction processing system shown in Figure 1a, according to some embodiments of the present invention.

[0025] In Figure 2, the apparatus 10 may include a signal processor or processing module 12 configured to receive signalling containing information about at least one acoustic characteristic of a froth layer 14 in a flotation cell or tank 16 of the flotation separation process shown in Figure 3 and determine a control characteristic related to the flotation separation process based at least partly on the signalling received. The signal processor or processing module 12 may also be configured to provide corresponding signalling, e.g., along signal path 18, containing information to control the flotation separation process based at least partly on the control characteristic determined.

[0026] The apparatus 10 may also include at least one acoustic detection means or device generally indicated as 20 shown in Figure 3 configured to sense the at least one acoustic characteristic of the froth layer 14 in the flotation cell 16 and provide the signalling S_1, S_2, S_3, S_4, S_5, S_6, e.g., along the signal path 18 (Figure 2), containing information about the at least one acoustic characteristic of the froth layer 14 in the flotation cell or tank 16 of the flotation separation process. In Figure 3, the at least one acoustic detection means or device 20 may include one or more of acoustic detection means or device labeled $AD20_1$, $AD20_2$, $AD20_3$, $AD20_4$, $AD20_5$, $AD20_6$. By way of example, and consistent with that shown in Figure 3, the flotation separation process may also include a reagent dosing device 30 configured to provide a reagent dosing to the flotation cell or tank, e.g., in response to a reagent dosing signal S_7, as well as an ore feed device 32 configured to provide or feed ore to the flotation cell or tank, e.g., in response to an ore feed signal S_8. Reagent dosing device like element 30 and ore feed device like element 32 are known in the art, and the scope of the invention is not intended to be limited to any particular type or kind thereof either now known or later developed in the future.

[0027] According to some embodiments of the present invention, acoustic sensing may be used to monitor the characteristics of the froth layer 14 in the flotation cell 16 to thereby maximize the recovery of ore. The acoustic characteristics of the froth layer 14 may then be used to control, e.g., the reagent dosing, ore feed rate, ore feed density, froth depth, superficial gas velocity or other aspects of the flotation cell, e.g., to maximize ore recovery.

[0028] According to some embodiments of the present invention, the acoustic characteristics of the ore may be monitored by using the acoustic detection means 20, such as by using one or more microphones. The acoustic detection means 20 may be placed above the froth layer 14 like elements $AD20_1$, $AD20_4$, directly in or near the froth layer 14 like elements $AD20_2$, $AD20_5$, or below the froth layer 14 like elements $AD20_3$, $AD20_6$, consistent with that shown in Figure 3. Acoustic detection means 20, such as elements $AD20_1$, $AD20_2$, $AD20_3$, $AD20_4$, $AD20_5$, $AD20_6$, including microphones, for placing, arranging, or configuring above, below or in the froth layer 14 are known in the art, and the scope of the invention is not intended to be limited to any particular type or kind thereof either now known or later developed in the future.

[0029] According to some embodiments of the present invention, where the acoustic detection means 20 is placed below the froth layer 14, such as elements $AD20_3$, $AD20_6$, the acoustic detection means may be configured to monitor the acoustics of the froth cell or tank 16 reflected at the interface between the froth layer 14 and the layer below, known as the pulp zone and generally indicated by reference label 15, due to the difference in acoustic impedance between the froth layer 14 and the pulp zone 15.

[0030] According to some embodiments of the present invention, the acoustic detection means 20 may be positioned at a number of locations, such as above, within, and/or below the froth layer to monitor the acoustic characteristics of the froth layer. In Figure 3, the two or more acoustic detection means 20 are placed above and below the froth layer 14, such as elements $AD20_1$, $AD20_4$ and $AD20_3$, $AD20_6$, in, near and below the froth layer 14, such as elements $AD20_2$, $AD20_5$ and $AD20_3$, $AD20_6$, or entirely within the froth layer 14, such as element $AD20_2$, so the acoustic detection means 20 may be configured to monitor the attenuation through the froth layer 14, between the froth layer 14 and the pulp zone 15, between the froth layer 14 and the air above the froth layer 14, or any combination.

[0031] According to some embodiments of the present invention, acoustic detection sensors, such as $AD20_2$, $AD20_4$ and $AD20_6$, may be mounted external to the flotation cell 16, e.g., including on an outside wall 17. In such embodiments, an acoustic guide or waveguide 18 may be placed within the flotation cell or tank 16 to optimize the acquisition of the acoustic signal. For example, the acoustic waveguide 20 may be placed within the flotation cell or tank 16 such that the acoustic waveguide 18 interacts with the solution in the flotation cell or tank 16 and gas bubbles, and the separate acoustic detection means $AD20_2$, $AD20_4$ and $AD20_6$ are mounted on the exterior, e.g., on the outside wall 17, of the flotation cell or tank 16 to acquire the acoustic signal from the acoustic waveguide 18.

[0032] According to some embodiments of the present invention, the acoustic detection means 20 may also be used to monitor the acoustic characteristics of bubbles in the pulp zone 15 to control the flotation cell or tank 16 to optimize ore recovery.

[0033] According to some embodiments of the present invention, the acoustic detection techniques described herein may also be augmented with acoustic sources AS_1, AS_2, AS_3, AS_4, AS_5 placed in the froth layer 14 like elements AS_4, under the froth layer 14 like elements AS_1, AS_2, next to the froth layer 14 like elements AS_3 or above the froth layer 14 like element AS_5. Acoustic sources are known in the art, and the scope of the invention is not intended to be limited to any particular type or kind thereof either now known or later developed in the future. Moreover, a person skilled in the art would be able to place, implement, arrange or configure the acoustic source in, under, next to or above the froth layer 14 consistent with that shown in Figure 3 and described herein without undue experimentation, and the scope of the invention of the invention is not intended to be limited to any particular type or kind of placement, implementation, arrangement or configuration of the acoustic source in, under, next to or above the froth layer 14 in order to implement the present invention consistent with that disclosed herein.

The Flotation Process

[0034] The present invention is described in relation to a flotation separation process, e.g., which may be configured to form part of the flotation process shown in Figure 1b, which itself may be configured to form part of the mineral extraction processing system shown in Figure 1a. However, the scope of the invention is not intended to include, or form part of, any particular type or kind of flotation process, or any particular type or kind of mineral extraction process system. For example, embodiments are envisioned in which the present invention may be implemented in other types or kinds of processes either now known or later developed in the future, including other types or kinds of flotation processes either now known or later developed in the future, as well as other types or kinds of mineral extraction process systems either now known or later developed in the future.

Figure 4: The Method

[0035] According to some embodiments, the present invention may take the form of a method to control of a flotation separation process, including parameters of the flotation process and reagent addition to optimize mineral recovery. By way of example, Figure 4 shows a flowchart generally indicated as 48 having steps 50, 52 and 54 for implementing the flotation separation process, including a step 50 for receiving signalling containing information about at least one acoustic characteristic of such a froth layer 14 in such a flotation cell or tank 16 of such a flotation separation process as shown in Figure 3, and a step 52 for determining a control characteristic related to the flotation separation process based at least partly on the signalling received, e.g., using such an apparatus 10, including such a signal processor or processing module 12. The method may also include a step 54 for providing corresponding signalling containing information to control the flotation separation process based at least partly on the control characteristic determined, and as well as one or more other steps for implementing the other functionality set forth herein according to some embodiments of the present invention.

The Signal Processor or Processing Module 12

[0036] According to some embodiments of the present invention, the functionality of the signal processor or processing module 12 may be implemented using hardware, software, firmware, or a combination thereof.

[0037] By way of example, and consistent with that shown and described herein, the signal processor or signal processing module 12 may be configured with at least one processor and at least one memory including computer program code, where the at least one memory and the computer program code are configured, with the at least one processor, to cause the apparatus at least to receive the signalling and determine the control characteristic in order to implement the present invention consistent with that disclosed herein.

[0038] In a typical software implementation, the signal processor or signal processing module 12 may include one or more microprocessor-based architectures having a microprocessor, a random access memory (RAM), a read only memory (ROM), input/output devices and control, data and address buses connecting the same. A person skilled in the art would be able to program such a microprocessor-based implementation to perform the functionality described herein without undue experimentation. The scope of the invention is not intended to be limited to any particular type or kind of signal processing implementation using technology either now known or later developed in the future.

Applications Re Other Industrial Processes

[0039] By way of example, the present invention is described in relation to, and part of, a mineral extraction processing system for extracting minerals from ore. However, the scope of the invention is intended to include other types or kinds of industrial processes either now known or later developed in the future, including any mineral process, such as those related to processing substances or compounds that result from inorganic processes of nature and/or that are mined from the ground, as well as including either other extraction processing systems or other industrial processes, where the sorting, or classification, of product by size is critical to overall industrial process performance.

REFERENCES CITED IN THE DESCRIPTION

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Patentkrav

1. Apparat omfattende:

en signalprocessor eller et signalprocessormodul konfigureret i det mindste til:

at modtage et signal indeholdende information om en akustisk dæmpning gennem et skumlag i en flotationscelle eller flotationsbeholder i en flotationsseparationsproces, eller mellem skumlaget og en pulpzone, eller mellem skumlaget og luft over skumlaget eller en hvilken som helst kombination; og

at bestemme et tilsvarende signal indeholdende information om en styreegenskab forbundet med flotationsseparationsprocessen baseret mindst delvist på det modtagne signal.

2. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at tilvejebringe det tilsvarende signal til styring af flotations-separationsprocessen baseret mindst delvist på den bestemte styreegenskab.

3. Apparat ifølge krav 1, hvor styreegenskaben vedrører parametre af flotations-separationsprocessen og reagenstilsætningen til optimering af mineralgenvinding.

4. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at anvende den akustiske dæmpning til styring af reagensdosering, malmtilførselshastighed, malmtilførselsdensitet, skumdybde, overfladegashastighed eller andre aspekter af flotationscellen til maksimering af malmgenvinding.

5. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signalet fra en akustisk detekteringsindretning, inklusiv en mikrofon, og inklusiv hvor signalprocessoren eller signalprocessormodulet er konfigureret til at monitorere den akustiske dæmpning af malm baseret mindst delvist på signalet modtaget fra den akustiske detekteringsindretning, eller inklusiv hvor den akustiske detekteringsindretning er placeret enten over skumlaget, eller direkte i skumlaget, eller under skumlaget.

6. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signalet fra en akustisk detekteringsindretning, inklusiv en mikrofon, placeret under skumlaget og til at monitorere akustik af en skumcelle reflekteret ved en grænseflade mellem skumlaget og et lag under skumlaget, inklusiv eller også kendt som en pulpzone, baseret mindst delvist på en forskel i en akustisk impedans mellem skumlaget og pulpzonen, eller hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signaler fra to eller flere akustiske detekteringsindretninger placeret over og under skumlaget, i og under skumlaget, eller fuldstændigt inde i skumlaget, og til at monitorere den akustiske dæmpning gennem skumlaget, mellem slumlaget og pulpzonen, mellem skumlaget og luften over skumlaget eller en hvilken som helst kombination, baseret mindst delvist på de modtagne signaler.

7. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signaler fra akustiske detekteringssensorer monteret uden for flotationscellen eller flotationbeholderen, inklusiv hvor signalerne modtages fra en akustisk guide placeret inde i flotationscellen eller flotationsbeholderen til optimering af opnåelse af et akustisk signal, eller inklusiv hvor signalet modtages fra en akustisk bølgeguide placeret inde i flotationscellen eller flotationsbeholderen, således at den akustiske bølgeguide interagerer med beholderopløsningen og gasbobler, og fra en separat akustisk detekteringsindretning monteret på ydersiden af flotationscellen eller flotationsbeholderen til opnåelse af det akustiske signal fra den akustiske bølgeguide.

8. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signalet fra akustiske detekteringsindretninger positioneret ved en række lokationer, inklusiv over, inde i, og/eller under skumlaget og til at monitorere de akustiske egenskaber af skumlaget.

9. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signalet fra en akustisk detekteringsindretning og til at monitorere de akustiske egenskaber af bobler i en pulpzone til styring af flotationscellen til optimering af malmgenvinding.

10. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet er konfigureret til at modtage signalet fra en akustisk detekteringsindretning forøget med akustiske kilder konfigureret, anbragt eller placeret i, under, ved siden af eller over skumlaget.

11. Apparat ifølge krav 1, hvor apparatet yderligere omfatter en akustisk detekteringsindretning, inklusiv en mikrofon, konfigureret til at tilvejebringe signalet, inklusiv hvor den akustiske detekteringsindretning er konfigureret, anbragt eller placeret enten over skumlaget, eller direkte i skumlaget eller under skumlaget.

12. Apparat ifølge krav 1, hvor apparatet yderligere omfatter to eller flere akustiske detekteringsindretninger konfigureret, anbragt eller placeret over og under skumlaget, i og under skumlaget, eller fuldstændigt inde i skumlaget, og konfigureret til at tilvejebringe signaler indeholdende information om akustiske egenskaber af skumlaget, eller hvor apparatet yderligere omfatter akustiske detekteringsindretninger positioneret ved en række lokationer, inklusiv over, inde i, og/eller under skumlaget og til at monitorere de akustisk egenskaber af skumlaget, konfigureret til at tilvejebringe signaler indeholdende information om de akustiske egenskaber af skumlaget.

13. Apparat ifølge krav 1, hvor apparatet yderligere omfatter akustiske detekteringssensorer monteret uden for flotationscellen eller flotationsbeholderen og konfigureret til at tilvejebringe signaler indeholdende information om akustiske egenskaber af skumlaget, inklusiv hvor apparatet yderligere omfatter en akustisk guide placeret inde i flotationscellen eller flotationsbeholderen for at optimere opnåelsen af et akustisk signal og konfigureret til at tilvejebringe signalerne indeholdende information om de akustiske egenskaber af skumlaget, eller inklusiv hvor apparatet yderligere omfatter en akustisk bølgeguide placeret inde i flotationscellen eller flotationsbeholderen, således at den akustiske bølgeguide interagerer med beholderopløsningen og gasboblerne, og omfatter en separat akustisk detekteringsindretning monteret på ydersiden af flotationscellen eller flotationsbeholderen for at opnå det akustiske signal fra den akustiske bølgeguide, idet den akustiske bølgeguide og den separate akustiske detekteringsindretning er konfigureret til at tilvejebringe signalerne indeholdende information om de akustiske egenskaber af skumlaget.

14. Apparat ifølge krav 1, hvor apparatet yderligere omfatter en akustisk detekteringsindretning forøget med akustiske kilder konfigureret, anbragt eller placeret i, under, ved siden af eller over skumlaget.

15. Apparat ifølge krav 1, hvor signalprocessoren eller signalprocessormodulet omfatter

mindst en processor og mindst en hukommelse inklusiv computerprogramkode, hvor den mindst ene hukommelse og computerprogramkoden er konfigureret, med den mindst ene processor, for at få apparatet til mindst at modtage signalet og bestemme styreegenskaben.

16. Fremgangsmåde omfattende:

at modtage signal indeholdende information om en akustisk dæmpning gennem et skumlag i en flotationscelle eller flotationsbeholder i en flotationsseparationsproces, eller mellem skumlaget og en pulpzone, eller mellem skumlaget og luft over skumlaget eller en hvilken som helst kombination; og

at bestemme et tilsvarende signal indeholdende information om en styreegenskab forbundet med flotationsseparationsprocessen baseret mindst delvist på det modtagne signal og under anvendelse af apparat, som inkluderer en signalprocessor eller et signalprocessormodul.

17. Fremgangsmåde ifølge krav 16, hvor fremgangsmåden yderligere omfatter at tilvejebringe det tilsvarende signal til styring af flotationsseparationsprocessen baseret mindst delvist på den bestemte styreegenskab.

DRAWINGS

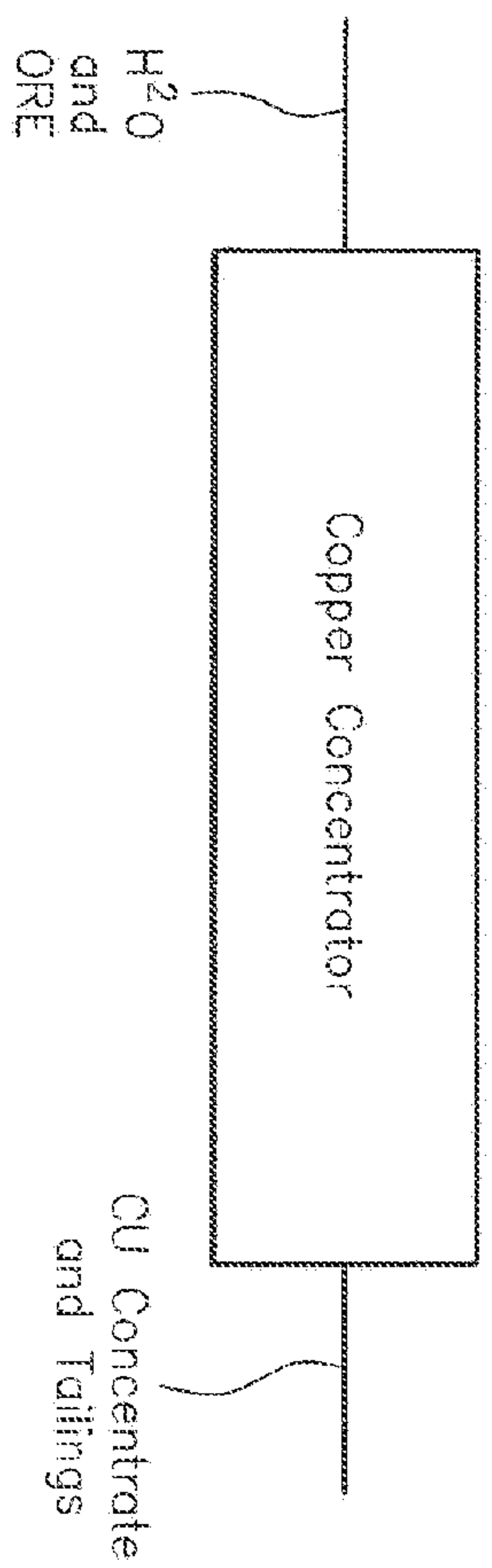

FIG. 1a : Mineral Extraction Processing System (PRIOR ART)

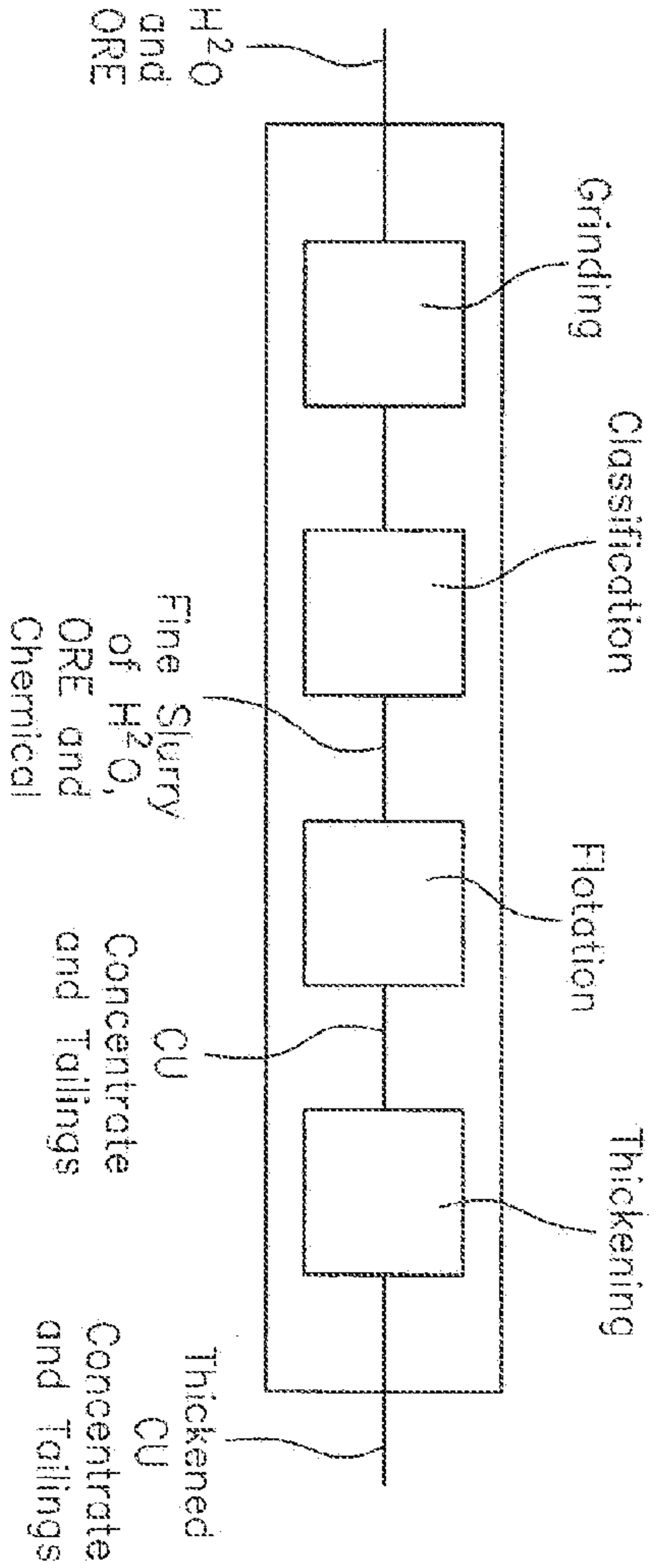

FIG. 1b (PRIOR ART)

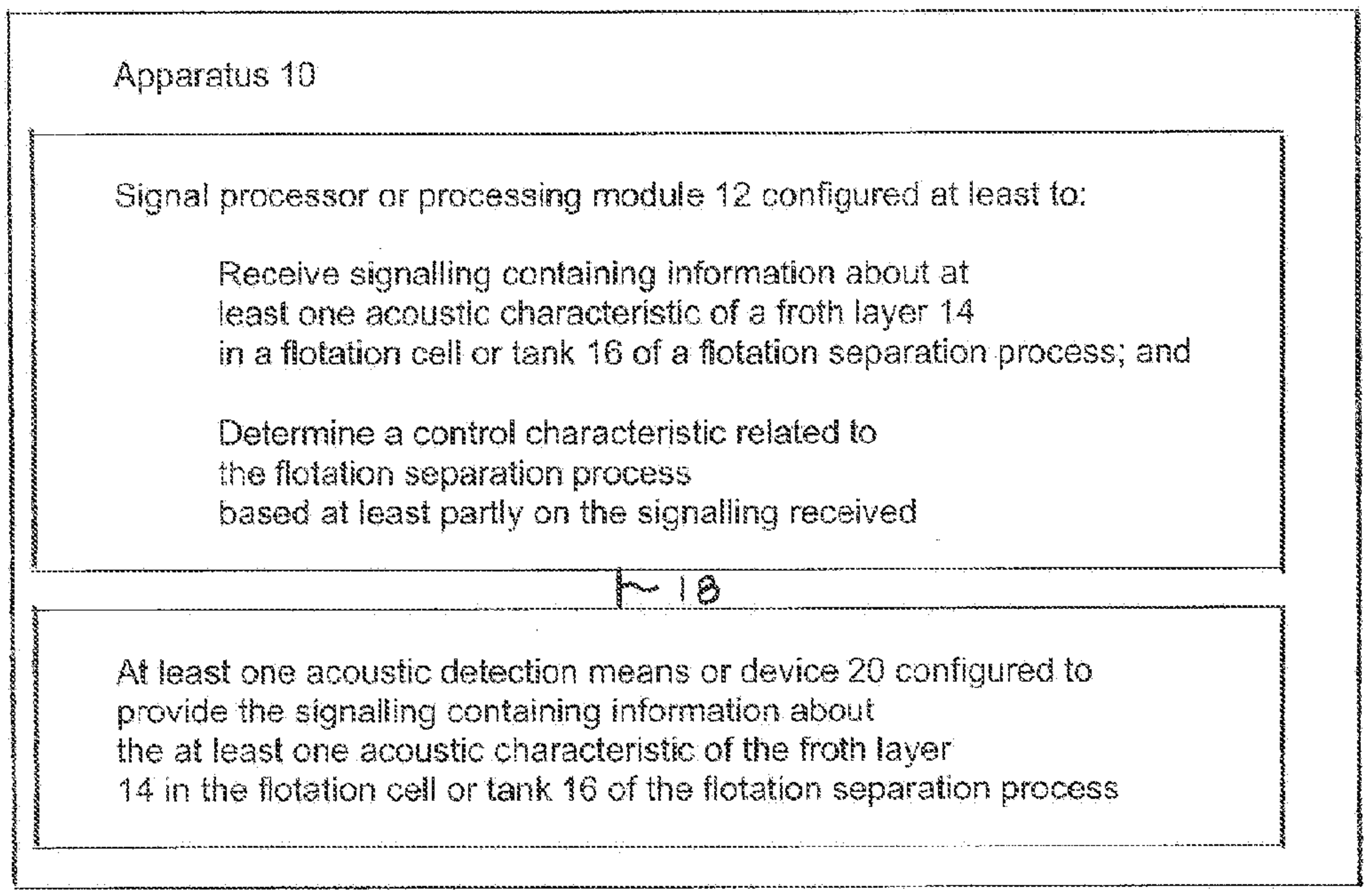

Figure 2

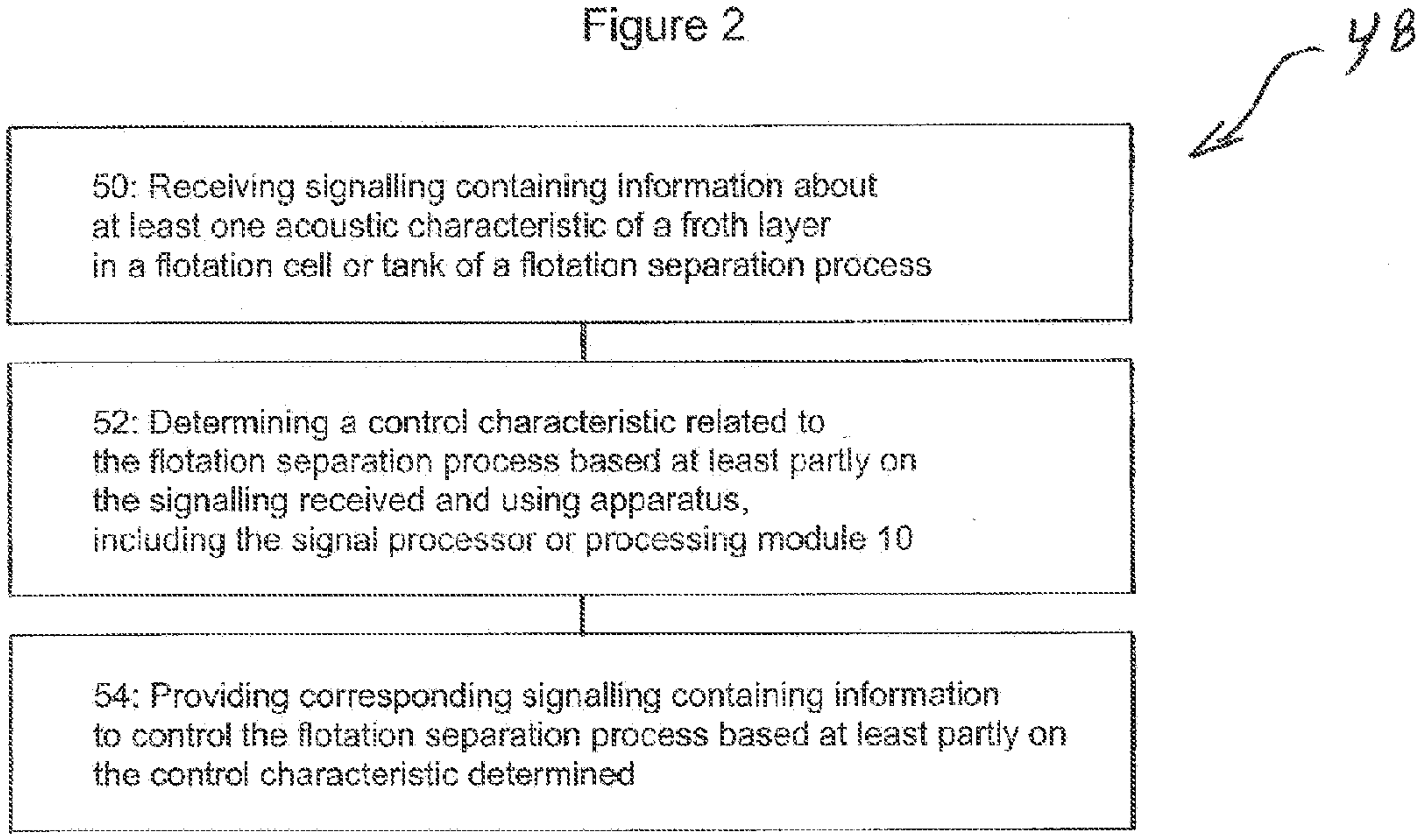

Figure 4

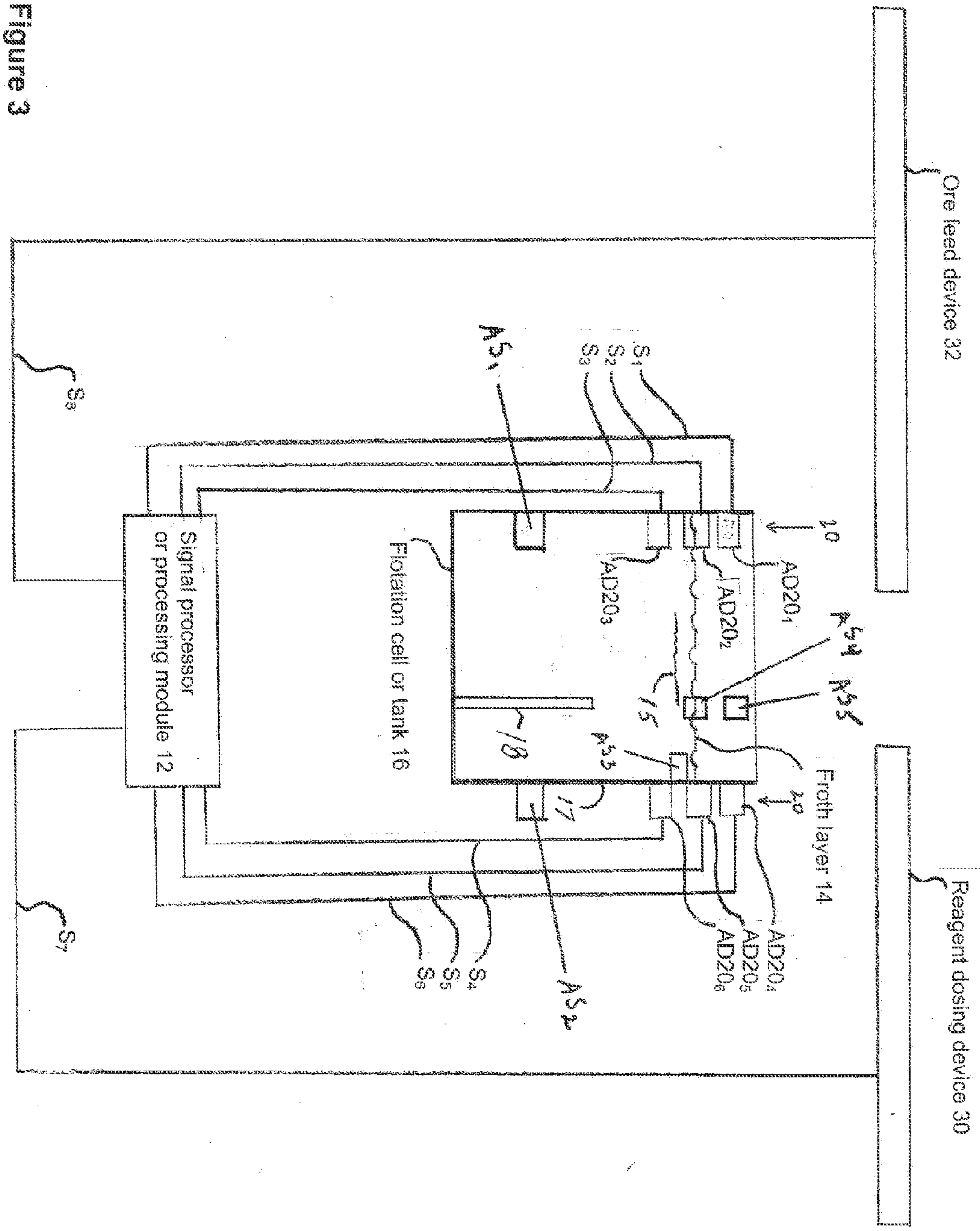
Ore feed device 32
Reagent dosing device 30
Signal processor or processing module 12
Flotation cell or tank 16
Froth layer 14
AD20₁
AD20₂
AD20₃
AD20₄
AD20₅
AD20₆
S1
S2
S3
S4
S5
S6
S7
S8
AS1
AS2
AS3
AS4
AS5
10
15
17
18
20

Figure 3