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(54) Title: Interstage Screening Apparatus

(57) Abstract: The invention relates to a screening apparatus for screening particles from a liquid or slurry in a main vessel such as an adsorption tank. Typically, a number of adsorption tanks are cascaded together, with each adsorption tank including a tank containing fine active carbon particles. A metal-laden slurry is passed through each tank in succession, with metal values being adsorbed onto the carbon particles. The screening apparatus includes a round cylindrical screening vessel having a lowermost inlet for receiving liquid or slurry from the main vessel via an airlift. The first outlet is located towards an upper end of the screening vessel for venting screened liquid or slurry, and a round cylindrical screening basket defines a screening volume between the inlet and the first outlet. An inwardly tapering base portion having an outlet conduit is located at a lower end of the screening basket. The base portion receives gravity fed particles from the screening volume and allows them to be fed back into the main tank via the outlet conduit.

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BACKGROUND OF THE INVENTION

THIS invention relates to screening apparatus for screening particles from a liquid or slurry.

Installations for recovering metal values such as gold by carbon-in-pulp (CIP) or carbon-in-leach (CIL) processes employ a plurality of adsorption tanks which are cascaded. Each tank contains fine active carbon particles, and a metal-laden slurry or leach solution comprising finely ground ore and water as well as reagents such as lime and cyanide is passed through each tank in succession, through a screening device. Metal values are adsorbed onto the carbon particles in each tank, and the carbon particles are retained on the outside of the screening device, which needs to be periodically scraped, with the leaner liquid or slurry passing through the screen to the next tank, where the process is repeated. Eventually, the carbon particles are collected for further processing.

In installations of this kind, the efficiency of the screening process and the circulation of the screened particles is important to the efficiency of the metal recovery process. At the same time, it is desirable to provide an installation which is relatively simple and robust in construction and which is reliable in use.

APR 97 / 01017

SUMMARY OF THE INVENTION

According to the invention screening apparatus for screening particles from a liquid or slurry in a main vessel comprises:

a screening vessel having an inlet at or adjacent to a lower end thereof for receiving liquid or slurry to be screened from the main vessel, and at least a first outlet at or adjacent an upper end thereof for screened liquid or slurry;

a screen element defining a screening volume within the screening vessel between the inlet which leads into the screening volume and the first outlet which is located outside the screening volumes; and

collection means arranged to direct excess liquid or slurry carrying the particles from the screening volume back into the main vessel.

The screening vessel and the screen element are preferably cylindrical, with the axis of the screen element being displaced relative to the axis of the screening vessel in a direction away from the first outlet, so that there is a spacing between the screen element and the screening vessel which increases in the direction of the first outlet.

The screening vessel may be provided with a second outlet at or adjacent a lower end thereof.

The second outlet is preferably located below the first outlet, is preferably smaller than the first outlet, and is configured as a de-sanding outlet.

Conveniently, the collection means comprises an inwardly tapering base portion having an outlet conduit, the base portion being located at a lower end of the screening volume for receiving gravity fed particles and for allowing them to be fed back into the main tank via the outlet conduit.

Advantageously, the inlet includes an inlet pipe communicating with an operatively lowermost portion of the screening vessel, the inlet pipe having an inlet towards a lower portion of the main vessel, the screening apparatus including an air lift for lifting the liquid or slurry through the inlet pipe into the screening volume.

Typically, the base portion is conical, and the operatively lowermost portion of the screening vessel is in the form of a conical bottom which is spaced from the conical base portion.

In one form of the invention, both the first and second outlets communicate with an outlet pipe.

Alternatively, only the first outlet communicates with the outlet pipe and the second outlet communicates with the screening vessel.

A sliding gate assembly may be provided for shutting off at least the first outlet.

The invention extends to a main vessel including at least one main adsorption tank having a motor-driven circulating impeller, the adsorption tank including at least one screening apparatus of the type described above.

BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1** is a plan view of a portion of a metal recovery installation incorporating screening apparatus according to the invention;
- Figure 2** is a schematic side view of a single tank of the installation of Figure 1;
- Figure 3** is a first side view of the screening apparatus;
- Figure 4** is a second side view of the screening apparatus;
- Figure 5** is a plan view of the screening apparatus of Figures 3 and 4; and
- Figure 6** is a side view of a screen element of the apparatus.

DESCRIPTION OF AN EMBODIMENT

Referring first to Figure 1, a portion of a metal recovery installation is shown in plan. The installation comprises a number of main adsorption tanks 10 arranged side-by-side in a cascaded configuration. Each tank contains a predetermined mass of activated carbon particles, and has a circulating impeller 12 driven by a motor 14 via a gearbox 16 (see Figure 2). The impeller is located centrally in the tank 10 and the motor and gearbox are mounted above the surface of the liquid or slurry 18 in the tank 10 on a frame (not shown).

Mounted within each tank 10 at the side thereof is a screening apparatus according to the invention, which comprises a round cylindrical screening vessel 20 having an inlet pipe 22 which extends downwardly approximately two thirds of the depth of the tank 10 and which is supported by brackets 24. An air lift comprising a compressed air pipe 26 extends through the pipe 22 with a nozzle 28 disposed below the end of the pipe 22, and is arranged to draw liquid or slurry from the interior of the tank 10 into the screening vessel. The screening vessel has an outlet 30 which passes screened slurry or liquid into the next tank 10, as well as an exhaust outlet 50 (see Figure 3) which returns the carbon particles screened from the slurry or liquid to the tank 10.

The screening vessel is illustrated more clearly in Figures 3, 4 and 5. The screening vessel is generally cylindrical and is constructed from 3mm mild steel plate. The screening vessel has a conical bottom 32 which flares upwardly from the inlet pipe 22 to the cylindrical side walls of the vessel. The vessel has a first, main outlet opening 34 towards its upper end, in communication with the outlet 30, as well as a secondary outlet opening 36 towards its lower end, below the opening 34.

Located within the screening vessel 20 is a cylindrical screen element 38 (see Figure 6) which comprises a frame or cage 40 fabricated from 25 x 5mm flat bar covered on the outside thereof with a 3mm layer of natural rubber. A screen cloth 42 covers the screen frame. Apertured lifting lugs 43 are provided at the top of the cage. In the prototype apparatus, the screen cloth had 700 micron apertures. The aperture sizes may naturally be changed, as required, to fit each application.

As is best seen in Figure 5, the axis of the screen element 38 is displaced relative to the axis of the screening vessel 20, so that the space 44 between the outer surface of the screen element and the inner surface of the screening vessel increases in a direction towards the outlet openings 34 and 36 and the main outlet 30. This has the effect of improving the flow of screened liquid or slurry away from the screen and out of the outlet. In this regard, the arrangement of the main and secondary outlet openings 34 and 36 is important. The main overflow opening 34 transmits the bulk of the output of the screening apparatus to the outlet 30. However, the secondary opening 36 serves as a de-sanding opening and prevents silting up of the screen.

Located within the screen element 38 co-axially therewith is a collection outlet 46 in the form of a conical base 48 connected to a detachable exhaust conduit 50 which empties into the main tank 10. The underside of the conical base is a high wear area, in that it constitutes a deflection surface for liquid or slurry entering the screening vessel 20 via the pipe 22. As a result, it is lined with a 3mm layer of natural rubber. The conical bottom 32 of the screening vessel and the top side of the conical base 48 is similarly rubber lined. The conical base 48 is bolted detachably to the conical bottom 32 by means of bolts 52 passing through spacer washers 54. The exhaust conduit 50 is mounted detachably to a spigot outlet 56 extending downwardly from the lowermost portion of the conical base 48. As a result, both the conical base 48 and the exhaust conduit 50, being wear parts, can easily be removed and replaced. Surplus liquid or slurry, together with the carbon particles retained by the screen, pass via the exhaust conduit 50 back into the main tank 10.

In an alternative embodiment of the invention, the outlet pipe 30 is

positioned adjacent the upper opening 34 as is indicated in broken outline at 30A so as to cater for a smaller level differential in adjacent absorption tanks 10. In this version, the secondary de-sanding opening 36 communicates directly with the main absorption tank.

As is shown in Figure 4 and in the detail in Figure 5, a slide gate 58 comprising a handle 60 and an elongate blade 62 is arranged to slide within a pair of opposed guide channels 64 for allowing the main and secondary outlet openings 34 and 36 to be selectively shut off for maintenance purposes. The guide channels 64 and the blade 62 are tapered slightly from top to bottom to allow for ease of removal of the blade from the channels.

Tests have shown that the described apparatus is effective in operation, with a high throughput for low energy consumption. Only a relatively small volume of compressed air is required to operate the apparatus. The apparatus provides a high screen cloth life, and is both inexpensive to construct and easy to maintain. Tests of the prototype apparatus showed that it could pass 65 to 75m³/hr of slurry at a density of 1:50, with a maximum particle size of 500 microns, through a screen cloth having an aperture size of 700 microns. Additional tests on larger screens have indicated that the screening apparatus of the invention can be sized to cater for most required throughputs, and in high throughput requirements more than one unit may be installed per main vessel 10 to cater for such throughputs.

Where cultivated carbon particles are mentioned, this may be read to include other metal recovery particles such as resin.

In prior art "outside-in" filtering arrangements, the particles are sucked onto

the outside of the filter screens, which they tend to clog. As a result, relatively expensive heavy duty screens need to be used, which need to be capable of withstanding periodic scraping.

One advantage of the screening apparatus of the invention is that it results in "inside-out" filtering, with the particles accumulating on the inside of the cylindrical screen element. The air lift creates a swirling effect which tends to prevent clogging by removing the accumulated particles and allowing them to be gravity fed back into the main tank via the conduit, with little or no scraping being required.

AP/P/97/01017

CLAIMS

1. A screening apparatus for screening particles from a liquid or slurry in a main vessel comprising:

a screening vessel having an inlet at or adjacent to a lower end thereof for receiving liquid or slurry to be screened from the main vessel, and at least a first outlet at or adjacent an upper end thereof for venting screened liquid or slurry;

a screen element defining a screening volume within the screening vessel between the inlet which leads into the screening volume and the first outlet which is located outside the screening volume; and

collection means arranged to direct excess liquid or slurry bearing the particles from the screening volume back into the main vessel.

2. A screening apparatus according to claim 1 in which the screen element and the screening vessel are cylindrical, with the axis of the screen element being displaced relative to the axis of the screening vessel in a direction away from the first outlet, so that there is a spacing between the screen element and the screening vessel which increases in the direction of the first outlet.
3. A screening apparatus according to either one of the preceding claims in which the screening vessel is provided with a second outlet at or

adjacent a lower end thereof.

4. A screening apparatus according to claim 3 in which the second outlet is smaller than the first outlet and is configured as a desanding outlet.
5. A screening apparatus according to any one of the preceding claims in which the collection means comprises an inwardly tapering base portion having an outlet conduit, the base portion being located at a lower end of the screen element for receiving gravity fed particles and for allowing them to be fed back into the main tank via the outlet conduit.
6. A screening apparatus according to any one of the preceding claims in which the inlet includes an inlet pipe communicating with an operatively lowermost portion of the screening vessel, the inlet pipe having an inlet situated towards a lower portion of the main vessel, and the screening apparatus including an air lift for lifting the liquid or slurry through the inlet pipe into the screening volume.
7. A screening apparatus according to claim 6 with reference to claim 5 in which the base portion is conical, and the operatively lowermost portion of the screening vessel is in the form of a conical bottom which is spaced from the conical base portion.
8. A screening apparatus according to either one of the preceding claims 3 or 4 in which both the first and second outlets communicate with an outlet pipe.

- 5 9. A screening apparatus according to either one of the preceding claims 3 or 4 in which the first outlet communicates with an outlet pipe and the second outlet communicates with the screening vessel.
- 10 10. A screening apparatus according to any one of the preceding claims which includes a sliding gate assembly for shutting off at least the first outlet.
11. A main vessel including at least one main adsorption tank having a motor-driven circulating impeller, the adsorption tank including at least one screening apparatus according to any one of the preceding claims.

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Ap/P/97/01017

FIG 1

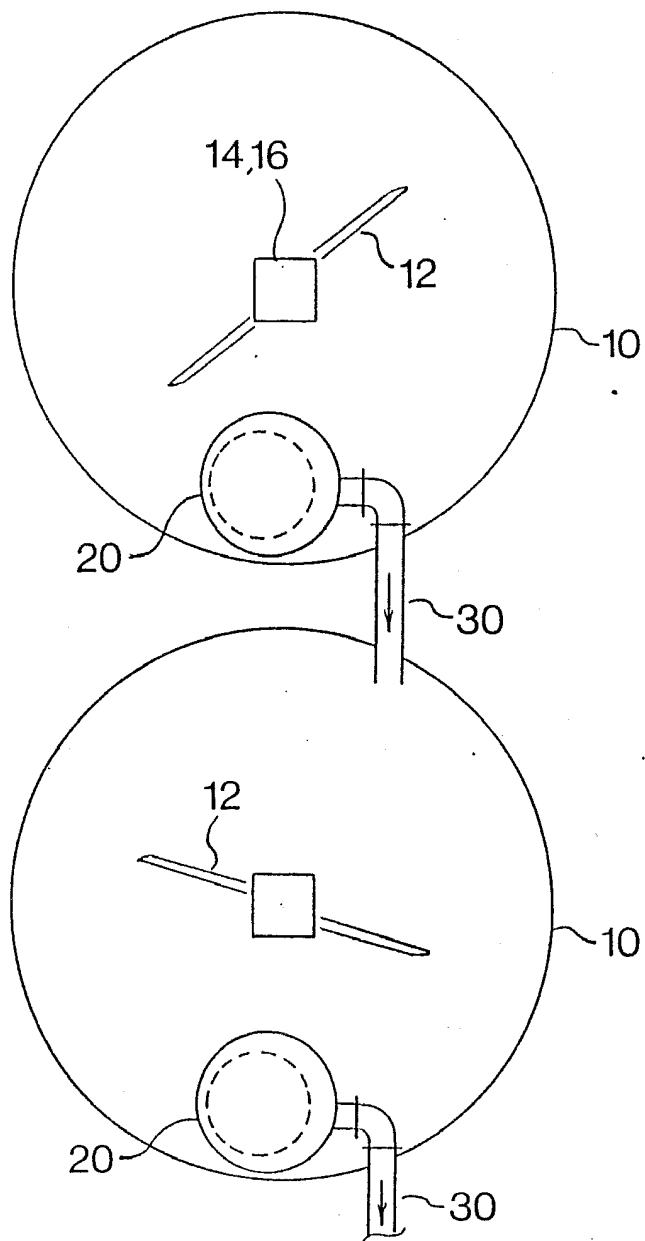
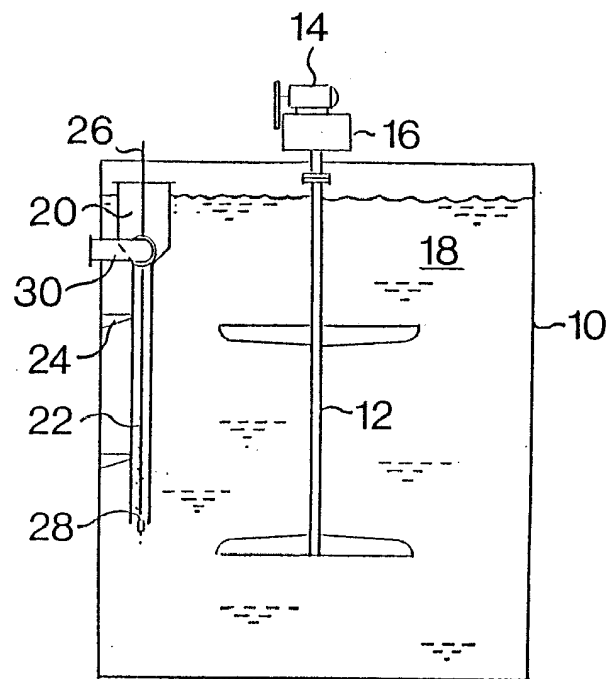
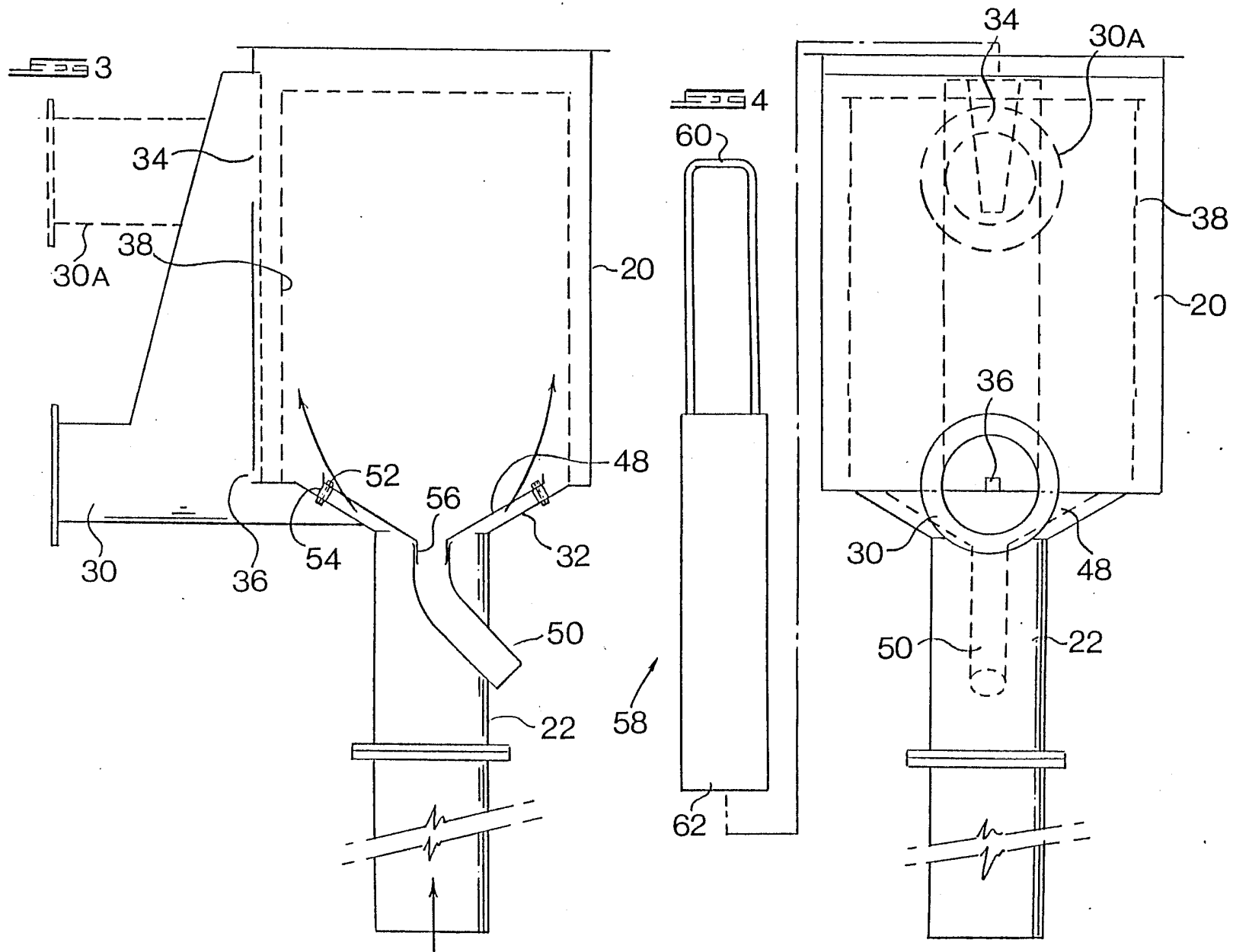


FIG 2



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Ap/P/97/01017



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