ORIGINAL

Abstract: [illegible]ices, systems and processes to treat slurries that include magnetic and nonmagnetic particles suspended in water in such a fashion as to separate certain valuable elements and/or minerals from less valuable minerals or elements A high intensity magnetic separator includes at least one large rotatable turntable that defines at least one circular channel therethrough in which a matrix material is positioned The turntable is configured to rotate in a generally horizontal plane about a generally vertical virtual axis, causing the at least one circular channel to rotate through a plurality of intermittent magnetic and nonmagnetic zones generated by a plurality of permanent magnet members A treatment slurry is directed into the channel or channels in one or more of the magnetic zones as the turntable rotates A tailings fraction passes through the channel or channels in a generally downward direction in the magnetic zones and is collected in tailings launders.

What is claimed is:

1. A high intensity magnetic separation device for separating a treatment slurry including magnetic particles and nonmagnetic particles suspended in water into a concentrate fraction and a tailings fraction, said device comprising:

a first generally horizontal rotor rotatable about a first generally vertical axis, said first rotor defining a first circular channel rotatable about the first axis, said first channel defining a flow path through said first rotor and containing a matrix material therein, wherein the first channel is configured to allow passage of a downwardly moving fluid stream therethrough in contact with the matrix material;

a first rigid support frame operable to support said first rotor;

a first driver mounted to said first support frame, said first driver operable to rotate said first rotor at a generally constant rate;

a first plurality of permanent magnet members fixedly attached to said first support frame, the first permanent magnet members positioned to straddle said first channel at a plurality of locations spaced apart along the circular path of said first channel, the first magnet members effective to apply magnetic fields across a plurality of portions of said path where said first channel is straddled by the first permanent magnet members, said portions defining a plurality of magnetic zones, said magnetic zones being separated along said circular path by nonmagnetic zones, thereby providing a repeating series of separation zones and nonmagnetic zones along said circular path;

a first plurality of feed conduits for delivering a treatment slurry into the first channel at a plurality of input locations, each input location being positioned within one of the plurality of magnetic zones defined by said first plurality of permanent magnet members;

a first plurality of water delivery conduits for delivering water into the first channel at a plurality of locations within the magnetic zones and within the nonmagnetic zones defined by said first plurality of permanent magnet members; and

a first plurality of tailings launders and a first plurality of concentrate launders positioned beneath said first channel; said first tailings launders positioned beneath said magnetic zones for receiving a first tailings fraction of the treatment slurry that passes through the first channel in said magnetic zones; and said first concentrate launders positioned beneath said nonmagnetic zones for receiving a first concentrate fraction of the treatment slurry that passes through the first channel in said nonmagnetic zones.

2. The device in accordance with claim 1 wherein said first rotor further comprises a foraminous channel floor operable to allow passage of the first tailings fraction therethrough as the first tailings fraction exits said first channel, and wherein said matrix material comprises a plurality of discreet magnetically susceptible objects sized to be retained in said first channel by said channel floor.

3. The device in accordance with claim 2 wherein said first rotor further comprises a plurality of vertical radial separating walls in said first channel, said separating walls dividing said first channel into a plurality of arc-shaped channel segments, and wherein at least one of said channel segments contains a plurality of said discreet magnetically susceptible objects.

4. The device in accordance with claim 3 wherein each of said channel segments contains a plurality of discreet magnetically susceptible objects.

5. The device in accordance with claim 2 wherein said magnetically susceptible objects comprise a material selected from the group consisting of steel, iron and an iron alloy.

6. The device in accordance with claim 5 wherein said magnetically susceptible objects comprise one or more members selected from the group consisting of shot, hex nuts, bolts, nails, washers, rod segments, cubes, blocks, cylinders, wire pieces, wire stars and pieces of wire mesh..

7. The device in accordance with claim 1, further comprising a plurality of jump magnets positioned adjacent said first channel at a trailing edge of a plurality of said magnetic zones relative to the rotation of said first rotor.

8. The device in accordance with claim 1 wherein said first rotor defines a first plurality of connected and spaced apart circular channels rotatable about the axis, each of said first plurality of channels defining a flow path through the first rotor and containing a matrix material therein, wherein each of said first plurality of channels is configured to allow passage of a downwardly moving fluid stream in contact with the matrix material contained therein.

9. The device in accordance with claim 1, further comprising:

a second generally horizontal rotor rotatable about the first axis or a second generally vertical axis, said second rotor defining a second circular channel rotatable about the first or second axis, said channel defining a flow path through said second rotor and containing a matrix material therein, wherein the second channel is configured to allow passage of a downwardly moving fluid stream in contact with the matrix material;

a second rigid support frame operable to support said second rotor;

a second driver mounted to said second support frame, said second driver operable to rotate said second rotor at a generally constant rate;

a second plurality of permanent magnet members fixedly attached to said second support frame, the second permanent magnet members positioned to straddle said second channel at a plurality of locations spaced apart along the circular path of said second channel, the second magnet members effective to apply magnetic fields across a plurality of portions of said path where said second channel is straddled by the second permanent magnet members, said portions defining a plurality of separations zones, said separation zones being separated along said circular path by nonmagnetic zones, thereby providing a repeating series of separation zones and nonmagnetic zones along said circular path;

a second plurality of feed conduits for delivering one or both of the first concentrate fraction and the first tailings fraction into the second channel at a plurality of input locations, each input location being positioned within one of the plurality of separation zones of the second channel defined by said second plurality of permanent magnet members;

a second plurality of water delivery conduits for delivering water into the second channel at a plurality of locations within the separation zones and within the nonmagnetic zones defined by said second plurality of permanent magnet members; and a second plurality of tailings launders and a second plurality of concentrate launders positioned beneath said second channel; said second tailings launders positioned beneath said separation zones for receiving a second tailings fraction that passes through the second channel in said separation zones; and said second concentrate launders positioned beneath said nonmagnetic zones for receiving a second concentrate fraction that passes through the second channel in said nonmagnetic zones.

10. The device in accordance with claim 9 wherein said second rigid support frame is integral with said first rigid support frame.

11. The device in accordance with claim 10 wherein both of said first and second rotors are rotatable about said first axis.

12. The device in accordance with claim 10 wherein said first rotor is positioned above said second rotor.

13. The device in accordance with claim 9 wherein at least one of said first and second rotors further comprises a foraminous channel floor operable to allow passage of a slurry therethrough as the slurry exits at least one of said first and second channels, and wherein said matrix material comprises a plurality of discreet magnetically susceptible objects sized to be retained in said first channel by said floor.

14. The device in accordance with claim 13 wherein at least one of said first and second rotors further comprises a plurality of vertical radial separating walls in at least one of said first and second channels, said separating walls dividing said at least one of said first and second channels into a plurality of arc-shaped channel segments, and wherein at least one of said channel segments contains a plurality of said discreet magnetically susceptible objects.

15. The device in accordance with claim 9 wherein at least one of said first and second rotors defines a plurality of connected and spaced apart circular channels rotatable

about the first or second axis, each of said first or second plurality of channels defining a flow path through the first or second rotor and containing a matrix material therein, wherein each of said first or second plurality of channels is configured to allow passage of a downwardly moving fluid stream in contact with the matrix material contained therein.

16. The device in accordance with claim 9, further comprising a plurality of jump magnets positioned adjacent one or both of said first channel and said second channel at a trailing edge of a plurality of said magnetic zones relative to the rotation of said first rotor or said second rotor.

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