Feb. 26, 1957 W. N. T. MORTON 2,782,925

CONTINUOUSLY OPERABLE CENTRIFUGAL ORE CONCENTRATOR

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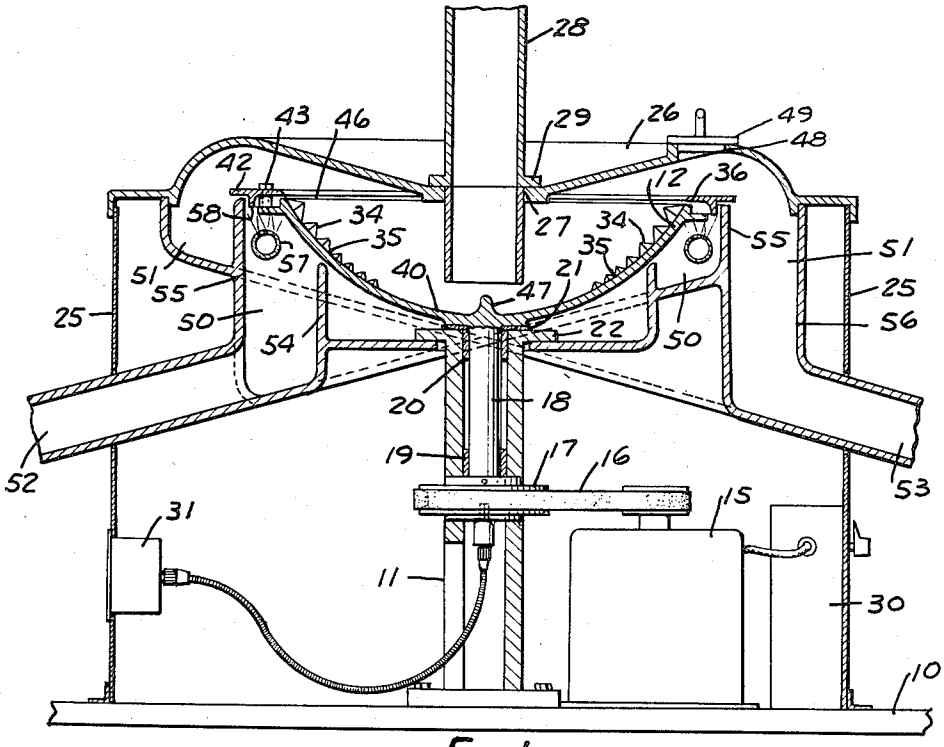



FIG 1

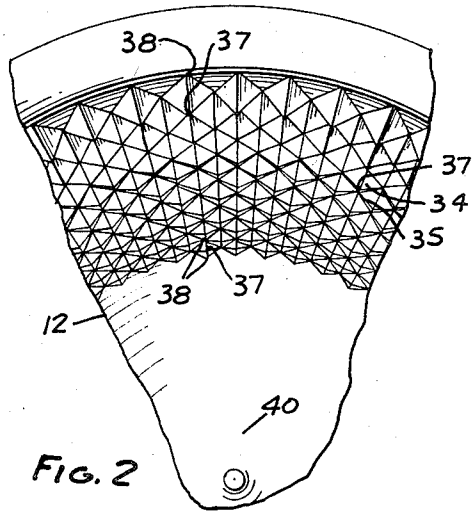



FIG. 2

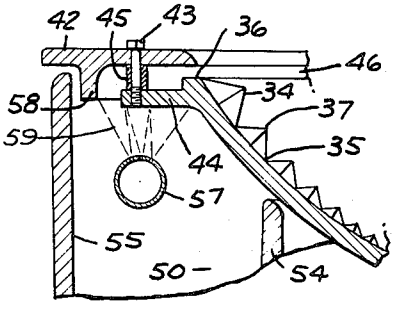



FIG. 3

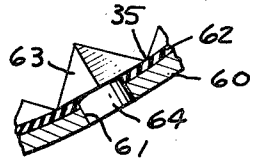



FIG. 4

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# CONTINUOUSLY OPERABLE CENTRIFUGAL ORE CONCENTRATOR

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20 Claims. (Cl. 209—211)

This invention relates to a centrifugal separator or concentrator for separating fractions of a fluent material.

The device is especially adapted for separating and collecting particulate matter contained in a liquid. An exemplary application of the invention is in separating relatively heavy valuable ore particles from a slurry of vein matter and collecting the ore particles while disposing of the gangue.

Heretofore such ore separators or concentrators have utilized rotary bowls lined with mesh materials for trapping the ore particles as they are separated from the gangue. When the mesh becomes saturated with ore, the machine must be stopped, the mesh removed from the bowl and the ore washed from the mesh. Operation of the machine is delayed until the mesh has been replaced. This periodic stoppage and cleaning is wasteful of machine hours and man hours and the mesh materials used for trapping the ore are subject to rapid wear through abrasion.

An object of this invention is to provide a simple, inexpensive, improved centrifugal ore concentrator structure which can be operated continuously.

The invention generally contemplates the use of a rotating bowl having a network of channels on its interior surface in which the heavies collect. The channels extend tortuously upwardly and terminate at an orifice below the top extremity of the bowl. The heavies are continually discharged through the orifice while the gangue is discharged over the top of the bowl. One form of the invention is shown in the accompany drawings:

Fig. 1 is a partly diagrammatic vertical section of a concentrator according to this invention.

Fig. 2 is an enlarged fragmentary plan view illustrat ing the bowl structure.

Fig. 3 is an enlarged fragmentary sectional view illustrating the orifice structure at the upper edge of the bowl.

Fig. 4 is an enlarged, fragmentary, partially sectional view illustrating a modified bowl structure.

The concentrator shown in the drawings includes a base 10, a support 11 on the base, and a bowl 12 rotatably mounted on the support. Bowl 12 is rotated by such means as an electric motor 15 through belting 16 and a pulley 17 fixed on a shaft 18 journaled within support 11 through bearings 19 and 20. The upper end of shaft 18 is fixed on bowl 12 and suitable bearing means 21 are provided at the top 22 of support 11 for bearing the weight of rotating bowl 12.

A housing for the machine is mounted on base 10 and includes sides 25 and a removable top or cover 26 centrally apertured as at 27 for receiving an inlet pipe 28 which has a locating projection 29. Controls 30 for motor 15 and instruments such as tachometer 31 may be mounted on the housing.

Bowl 12 is preferably round in plan and is preferably curved in section. Bowl 12 is illustrated as having generally spherical form but the shape of the bowl may be



varied. The interior of the bowl is lined around its circumference with a number of projections 34. The projections are arranged so that the depressions between them define a reticulate system of tortuous channels 35 extending from a location near the bottom of the bowl to the upper edge 36 of the bowl body. To this end the projections may have pyramidal form with their apices 37 and diagonally opposite corners 38 of their bases aligned generally or meridians of the bowl (Fig. 2).

The projections near the bottom of the bowl are relatively small and the upper projections increase progressively in size proportionally to the increasing diameter of the bowl at greater heights above the bowl bottom 40. With this arrangement the adjacent sides of projections 34 define channels 35 having zigzag shape and extending generally along meridians of the bowl body. The channels are interconnected to form a reticulate system and terminate at top edge 36 of the bowl body. The channels are shallowest adjacent the lower portion 40 of the bowl and increase in depth progressively toward the top of the bowl because of the increased size of projections 34.

A circumferential rim 42 is axially shiftably secured adjacent upper edge 36 of the body by such means as bolts 43 threaded to projections 44 on the bowl body, and a block or sleeve 45 of a resiliently compressible material such as a natural or synthetic rubber is disposed around each bolt 43 between rim 42 and projections 44. Rim 42 defines the top side of bowl 12 and the rim and bowl body cooperate to define a circumferential orifice 46 adjacent thereto. Accordingly the upper ends of the channels 35 open into orifice 46. Rim 42 is shifted axially by turning bolts 43 for adjusting the size of orifice 46 and cover 26 is provided with a hand hole 48 and removable cover 49 therefor to facilitate access to bolts 43. Bowl 12 has an internal upward projection 47 axially aligned with inlet pipe 28 for a purpose to be described.

Support 11 supports a discharge manifold structure preferably including an inner passageway 50, a circumjacent outer passageway 51 and discharge ducts 52 and 53 connected respectively thereto. Passageway 50 is defined in part by inner and outer vertically extending walls 54 and 55 and outer passageway 51 is defined in part by wall 55 and an outer vertical wall 56. Rim 42 defines the top of passageway 50 and preferably has a depending annular projection 58 adjacent wall 55 and forming a seal. A running clearance is provided between ring 58 and wall 55 as shown. Cover 26 may be supported by outer wall 56 as shown and forms the top portion of outer passageway 51. A spray pipe 57 is provided in passageway 50 and is arranged to spray water against portions of the passageway adjacent orifice 46 as illustrated at 59.

In use, it may be assumed that bowl 12 is being rotated at a predetermined speed by motor 15. A slurry of vein material or muck containing an ore to be separated is introduced into the bowl through pipe 28. Projection 47 diverts the slurry radially outwardly of the bottom of the bowl. The slurry is spun by the bowl and the heavy valuable ore particles are forced centrifugally toward the outer portions of the bowl interior. The ore collects in channels 35 and tends to travel upwardly along the sides of the bowl.

The upward progress of the separated ore or heavies is retarded by the zigzag or tortuous shape of the channels so that the ore moves relatively slowly toward the upper ends of the channels and orifice 46. Channels 35 are progressively deeper in an upward direction to accommodate greater accumulations of ore particles in upper portions of the bowl. Meanwhile the relatively lighter, more voluminous waste material or gangue is forced more

rapidly up the sides of the bowl over projections 34 by the centrifugal action and pours over the top edge of the bowl provided by circumferential rim 42.

The heavies which discharge from bowl 12 through orifice 46 pass through passageway 50 and are carried out of the machine through conduit 52 for further processing. The gangue discharges into outer passageway 51 and is disposed of through conduit 53. The heavies may be in relatively dry condition upon entering passageway 50. Spray 58 issuing from pipe 57 against upper portions of passageway 50 aids in washing the heavies through discharge duct 52. Vertical wall 54 shields bearing 21 from material discharging into inner passageway 50. Annular projection 58 cooperates with wall 55 to form a seal preventing the loss of ore discharging through orifice 46.

The machine may be operated continuously so long as bowl 12 is being rotated by motor 15. The ore concentrated in channels 35 is continually discharged through orifice 46 and the gangue is continually discharged over rim 42. No stoppage is necessary for recovering ore from within the bowl. Bowl 12 may be rotated at varying speeds depending on the requirements of the material by means of controls represented at 30. The size of orifice 46 may be adjusted according to the requirements of the material by turning bolts 43 to shift rim 42 axially toward and away from the top edge 36 of the bowl body. Resilient sleeves 45 compressed between rim 42 and lugs 44 supports the rim in adjusted position.

In a typical operation, for example in separating certain zirconium ores, orifice 46 is set at .016 inch and bowl 12 is rotated at about 500 R. P. M. Pipe 28 and cover 26 may be removed for maintenance purposes by merely lifting them upwardly and may be replaced by setting them in place on the top of housing 25 and walls 56 as shown.

The modified form of the invention illustrated in Fig. 4 is similar to the principal form except that bowl 60 is provided with a number of series of openings 61 arranged along meridians of the bowl and is lined with a layer 62 of tough, abrasion resisting material such as a natural or synthetic rubber or a plastic material. The projections on the interior of the bowl are provided by pyramidal studs 63 preferably formed of a hard steel and having projecting portions 64 press fitted into openings 61. The pyramidal heads of studs 63 cooperate to define channels 35 and use of this form of the invention is similar to use of the principal form. Studs 63 may be removed and replaced when their heads become worn through abrasion.

I claim:

1. A continuously operating centrifugal separating device comprising, a support, means forming a vessel adapted to contain fluent material, means rotatably mounting said vessel on said support, means operable to rotate said vessel, said vessel having an open upper side, said vessel having orifice means adjacent said upper side, means forming a system of channels on the interior of said vessel, said channels being angled to meridians of said vessel and terminating adjacent said orifice means so that relatively heavy particulate matter separated centrifugally from fluent matter in said vessel passes through said channels for discharge through said orifice means.

2. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.



3. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a reticulate system of channels extending around the interior of said bowl and extending upwardly from a location adjacent the bottom thereof, said channels being angled to meridians of said bowl and terminating adjacent said orifice means, said channels being relatively shallow near the bottom of said bowl and being progressively deeper in the upper portions of said bowl so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

4. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a plurality of projections on the interior of said bowl, said projections being disposed generally along meridians of said bowl and cooperating to define a reticulate system of channels on the interior of said bowl, said channels extending upwardly from locations adjacent the bottom of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

5. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a plurality of series of projections on the interior of said bowl, said series of projections extending generally along meridians of said bowl and extending upwardly from a location adjacent the bottom of the bowl, said projections having adjacent bases cooperating to define a reticulate system of tortuous channels on the interior of said bowl, the projections adjacent the bottom of the bowl being relatively small, the projections being progressively larger in upward portions of the bowl so that said channels are progressively deeper in said upward portions of the bowl, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

6. The device defined in claim 5 wherein said projections are tapered inwardly of said bowl.

7. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a plurality of series of projections on the interior of said bowl, said series of projections extending generally along meridans of said bowl and extending upwardly from a location adjacent the bottom of the bowl, said projections having pyramidal form, the apices and diagonally opposite corners of the bases of said projections being aligned generally along meridians of the bowl, the bases of said projections being disposed adjacent one another, said projections cooperating to define a reticulate system of

tortuous channels on the interior of said bowl, the projections adjacent the bottom of the bowl being relatively small, the projections being progressively larger in upward portions of the bowl so that said channels are progressively deeper in said upward portions of the bowl, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

8. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, said bowl having a plurality of integrally formed projections on its interior, said projections being disposed generally along meridians of said bowl and cooperating to define a reticulate system of channels on the interior of said bowl, said channels extending upwardly from locations adjacent the bottom of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

9. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, said bowl having a plurality of series of openings therein, said series being arranged generally along meridians of said bowl, a plurality of studs, said studs having portions frictionally engaging within said openings, said studs having other portions forming projections extending interiorly of said bowl, said projections cooperating to define a reticulate system of channels on the interior of said bowl, said channels extending upwardly from locations adjacent the bottom of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

10. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a resilient, abrasion resistant lining on the interior of said bowl, said lining and bowl having a plurality of openings arranged generally along meridians of the bowl, the openings in said liner and said bowl being in registry, a plurality of studs, said studs having portions fixed frictionally within said openings in said bowl, said studs having head portions forming projections extending interiorly of said bowl, said projections cooperating to define a reticulate system of channels on the interior of said bowl, said channels extending upwardly from locations adjacent the bottom of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.

11. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having a body and having a circumferentially extending rim, said rim defining an open upper side of said bowl over which gangue is discharged in operation, said rim being spaced from said body to define a circumferential orifice adjacent the top of said bowl, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means.



12. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having a body and having a circumferentially extending rim, mounting means securing said rim on said body, said rim and body cooperating to define a circumferential orifice adjacent the top of said bowl, said mounting means being operable to shift said rim axially of said bowl body to regulate the size of said orifice, said rim defining an open upper side of said bowl over which gangue is discharged in operation, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice so that relatively heavy ore particles separated centrifugally from the gangue pass through said channels for discharge through said orifice.

13. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue passes through said channels for discharge through said orifice means, means forming a closure for said bowl, said closure having two generally concentric passageways, said orifice means communicating into one of said passageways, the other of said passageways opening at the upper side of said bowl to facilitate disposal of gangue independently of heavy ore separated therefrom.

14. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having a body and having a circumferentially extending rim, mounting means securing said rim on said body, said rim and body cooperating to define a circumferential orifice adjacent the top of said bowl, said mounting means being operable to shift said rim axially of said bowl body to regulate the size of said orifice, said rim defining an open upper side of said bowl over which gangue is discharged in operation, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue pass through said channels for discharge through said orifice, means forming a closure for said bowl, said closure having generally concentric passageways, said rim forming a partition between said passageways, said orifice communicating into one of said passageways and the other passageway opening at the open upper side of said bowl so that gangue and heavy ore particles are discharged from said bowl independently.

15. In an ore concentrator of the type having a rotary bowl for centrifugally separating heavy ore particles from a slurry, bowl structure comprising, means forming a bowl having an open upper side, said bowl having orifice means adjacent said upper side, means forming a system of channels on the interior of said bowl, said channels extending generally upwardly from a lower portion of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that heavy ore particles

separated from a slurry in the bowl pass through said channels for discharge through said orifice means.

16. In an ore concentrator of the type having a rotary bowl for centrifugally separating heavy ore particles from a slurry, bowl structure comprising, means forming a bowl having an open upper side, said bowl having orifice means adjacent said upper side, means forming a plurality of projections on the interior of said bowl, said projections being disposed generally along meridians of said bowl and cooperating to define a reticulate system of channels on the interior of said bowl, said channels extending generally upwardly from a lower portion of said bowl and having tortuous form, said channels terminating adjacent said orifice means so that heavy ore particles separated from a slurry in the bowl pass through said channels for discharge through said orifice means.

17. The device defined in claim 16 wherein said projections are tapered inwardly of said bowl.

18. The device defined in claim 16 wherein said projections have pyramidal form, the apices and diagonally opposite corners of the bases of said projections being aligned generally along meridians of the bowl.

19. The device defined in claim 16 wherein the projections in the lower portions of the bowl are relatively small, said projections being progressively larger in upper portions of the bowl.



20. A continuously operating centrifugal ore concentrator comprising, a support, a bowl adapted to contain a slurry, means rotatably mounting said bowl on said support, means operable to rotate said bowl, said bowl having an open upper side to facilitate free discharge of gangue therefrom, said bowl having orifice means adjacent said upper side, means forming a reticulate system of channels on the interior of said bowl, said channels being angled to meridians of said bowl and terminating adjacent said orifice means so that relatively heavy ore particles separated centrifugally from the gangue pass through said channels for discharge through said orifice means, means forming a closure for said bowl, said closure having two generally concentric passageways, said orifice means communicating into one of said passageways, the other of said passageways opening at the upper side of said bowl to facilitate disposal of gangue independently of heavy ore separated therefrom, and spray means in said one passageway, said spray means being arranged to direct a spray of water against portions of the interior of said one passageway generally adjacent said orifice means to facilitate washing the heavy ore through said one passageway.

No references cited.