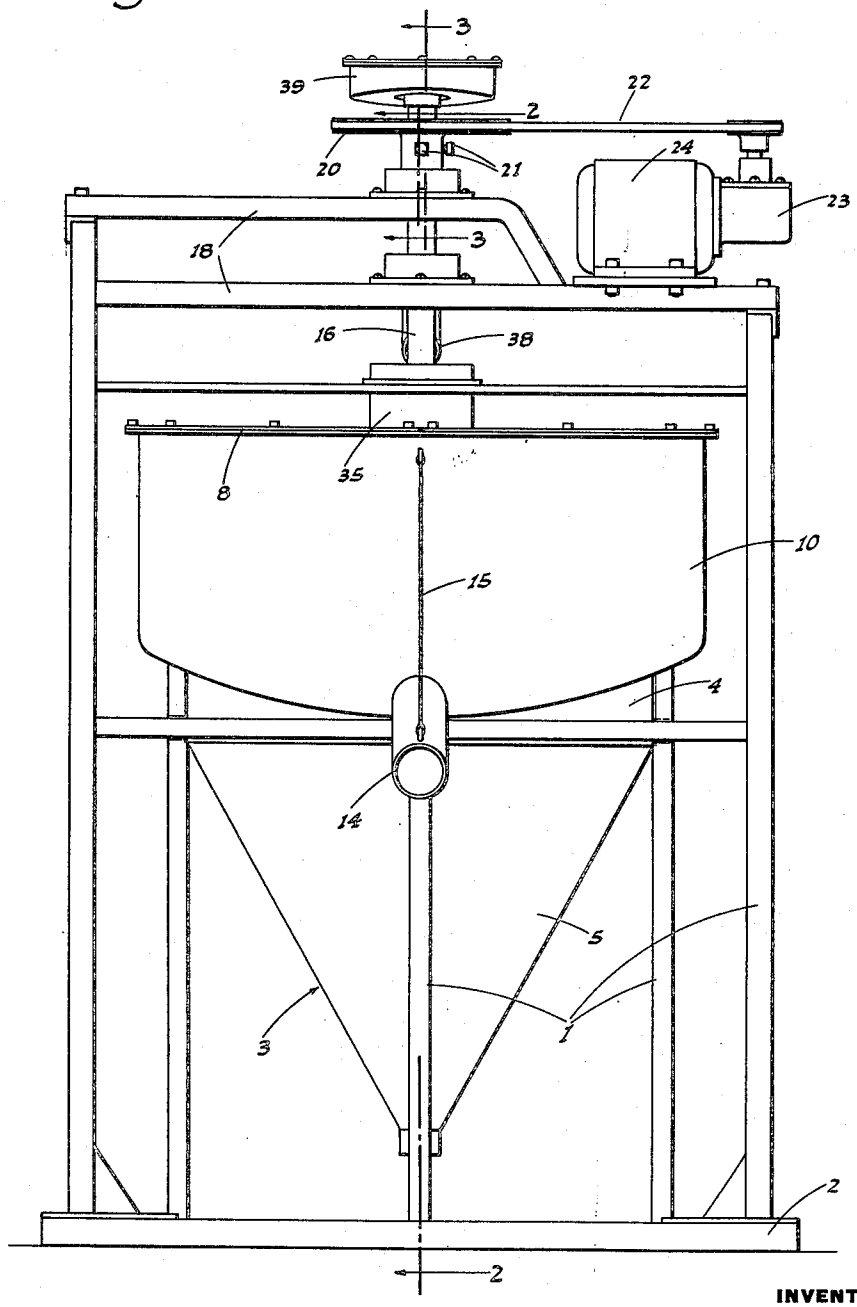
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CONCENTRATOR

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Fig. 1



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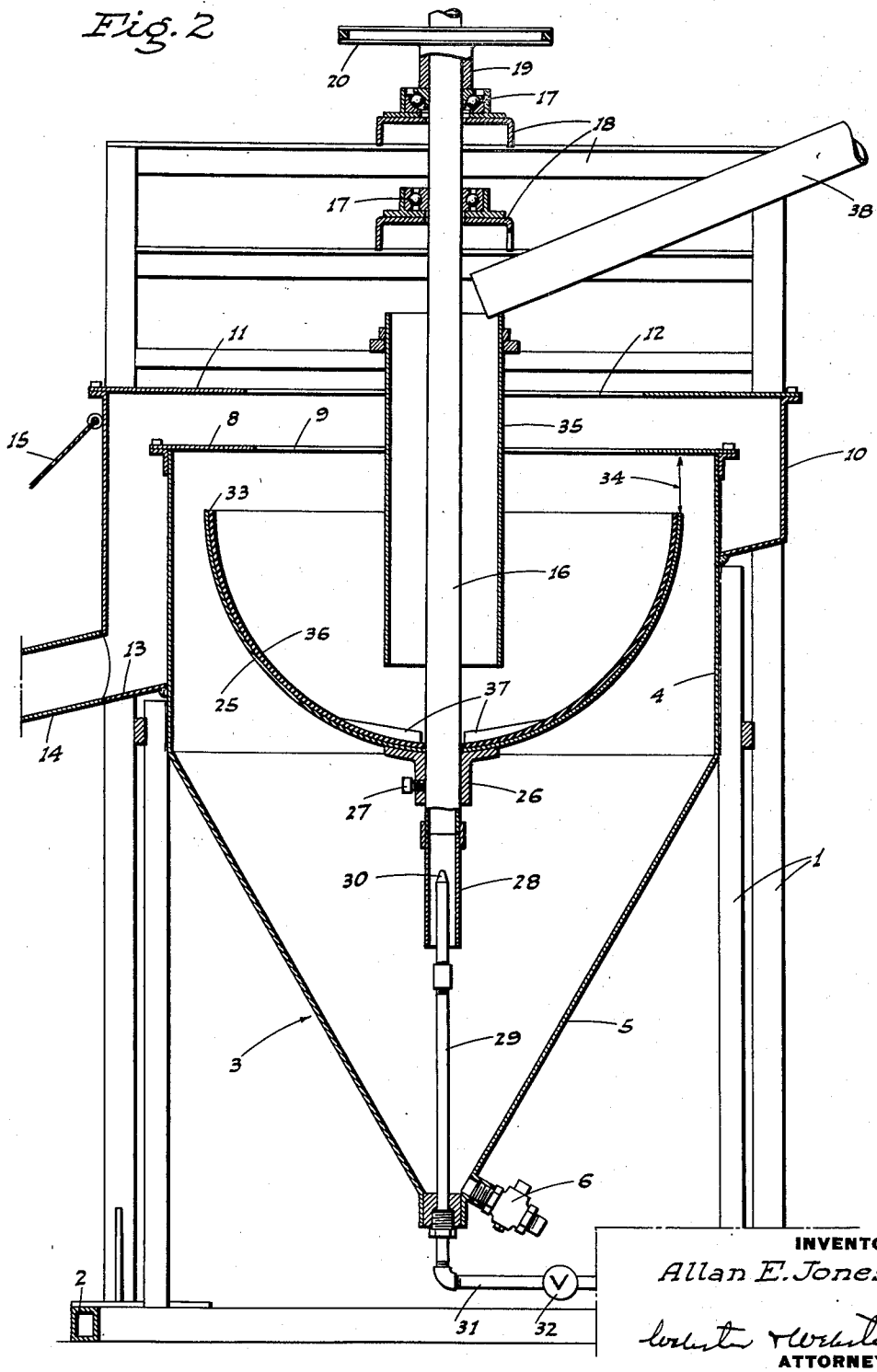
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Fig. 2



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Fig. 3

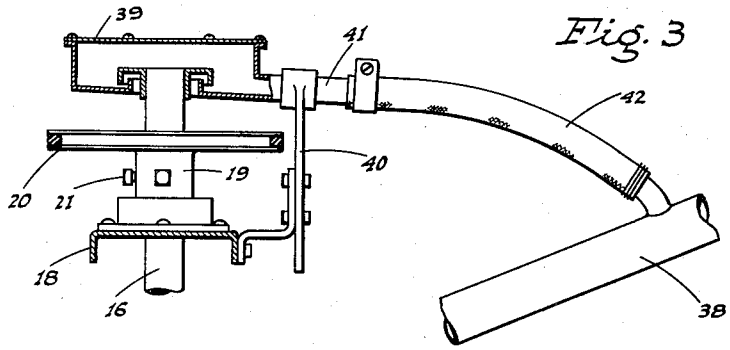
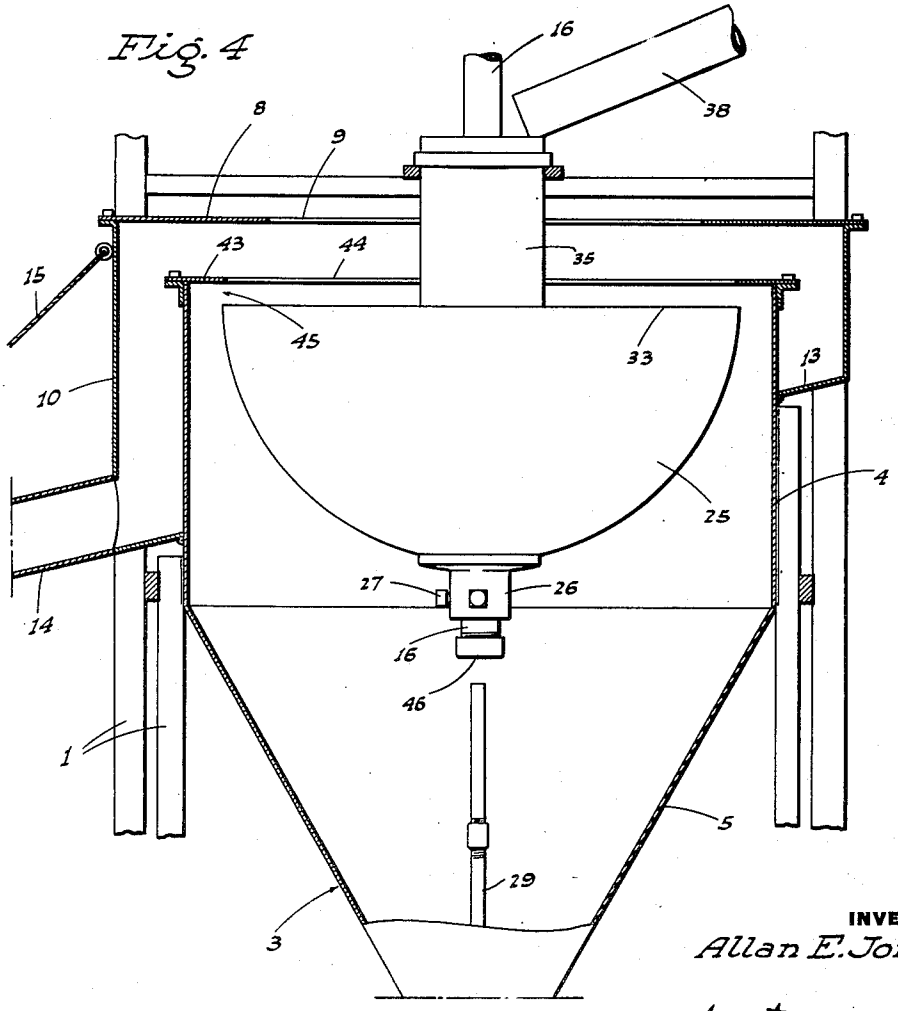


Fig. 4



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CONCENTRATOR

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8 Claims. (Cl. 209—159)

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This invention relates generally to the art of concentrating ores when in the form of a water pulp.

In particular the invention is directed to, and it is a major object to provide, a concentrator of novel construction and function; the concentrator being of centrifugal type and including a unique arrangement between an included centrifugal bowl and concentrator tank for the division or separation of the granular fractions, the heavier of such fractions being recovered and the lighter fractions discharged.

Another object of the invention is to provide a classifier which is constructed in a manner which permits of ready adjustment of the centrifugal bowl relative to a cooperating part of the concentrator tank; such adjustment being for the purpose of attaining effective control of the degree of concentration of the granular fractions. In other words, the apparatus can be set to obtain a fine concentration of the water pulp ore, or a classification or rough concentration, as working conditions may require.

An additional object of the invention is to provide a concentrator which functions effectively to remove slimes and excess water from the ore pulp, thus materially aiding in the concentrating process.

A further object of the invention is to provide a concentrator which operates continuously and has a high capacity; the structure nevertheless being relatively simple, and the apparatus requiring relatively small power means to drive the same.

A still further object of the invention is to provide a concentrator which includes a novel arrangement for recycling middlings through the concentrator, whereby its efficiency is increased.

It is also an object of the invention to provide a concentrator which is designed for economical construction and operation; the concentrator being relatively simple but sturdy in structure, and in normal size readily portable from place to place.

Still a further object of the invention is to provide a practical and reliable concentrator, and one which will be exceedingly effective for the purpose for which it is designed.

These objects are accomplished by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings:

Fig. 1 is a side elevation of the concentrator.

Fig. 2 is a sectional elevation of the same taken on line 2—2 of Fig. 1.

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Fig. 3 is a fragmentary sectional elevation of the top launder; the view being taken on line 3—3 of Fig. 2.

Fig. 4 is a fragmentary elevation, partly in section, showing the centrifugal bowl as adjusted to a position for fine concentration of the ore pulp.

Referring now more particularly to the characters of reference on the drawings, and at present to Figs. 1–3 inclusive, the concentrator comprises an upstanding skeleton frame, indicated generally at 1, supported by a base 2.

A vertically elongated concentrator tank, indicated generally at 3, is fixed in the frame 1, and such tank includes a cylindrical upper portion 4, and a lower portion which is in the form of an inverted cone 5; there being a clean-out valve 6 in communication with said cone immediately adjacent its lower end. The lower end of the cone 5 is fitted with a plug 7.

At its upper end the concentrator tank 3 carries a horizontal top plate 8 having a relatively large-diameter, circular opening 9 therein concentric to the axis of said tank 3.

The cylindrical upper portion 4 of the concentrator tank 3 is surrounded by a circular launder 10 which extends a distance above the top plate 8; such launder 10 likewise including a top plate 11 having a circular opening 12 therein. The launder 10 has a bottom 13 which slopes from one side to the other of the apparatus, and at the low side said launder communicates with an outlet spout 14 suspended by a cable 15.

A vertical tubular shaft 16 is journaled, intermediate its ends and above the launder 10, by bearings 17 supported by cross members 18 in the upper portion of the frame 1. The uppermost one of the bearings 17 is of thrust type and supports the hub 19 of a pulley 20; such hub being relatively adjustable on the tubular shaft 16 by means of set screws 21.

With this arrangement, the tubular shaft 16 is vertically adjustable for the purpose which will hereinafter appear; such shaft depending into the concentrator tank 3 but terminating in the latter some distance above its lower end.

The tubular shaft 16 is normally constantly driven by an endless belt and pulley unit 22 which includes the pulley 20; such unit being driven from a reduction gear box 23 actuated by an electric motor 24 mounted on the upper end of the frame 1.

Within the cylindrical upper portion 4 of the concentrator tank 5, the apparatus includes an upwardly opening, semi-spherical centrifugal bowl 25; such bowl being mounted on the tubular

shaft 16, for rotation therewith, by a hub 26 at the bottom of the bowl secured by set screws 27 to said shaft 16 adjacent but short of its lower end.

The tubular shaft 16 is fitted, below the hub 26, with a detachable, relatively short downward extension 28, and a standpipe 29 extends through the plug 7 and projects upwardly in coaxial relation to said extension 28. At its upper end the standpipe 29 is fitted with a jet nozzle 30 which projects into the extension 28 in substantial clearance relation. A supply pipe 31, for water under pressure, connects to the lower end of the standpipe 29, and said pipe 31 includes a control valve 32 therein.

The centrifugal bowl 25 is of a diameter at its upper edge 33 somewhat lesser than the diameter of the cylindrical upper portion 4 of the concentrator tank 3, but is of greater diameter than that of the circular opening 9. As a result said upper edge 33 of the centrifugal bowl 25 works in cooperation with the horizontal top plate 8 radially outwardly of said opening 9; the spacing between said edge 33 of the bowl 25 and the top plate 8 being indicated at 34, and being of substantial importance in connection with the operation of the machine, as will hereinafter be described.

A vertical tubular feed well 35 is fixed in connection with the frame 1 above the bowl 25, surrounding the tubular shaft 16 in spaced relation and depending into said bowl. At its lower end the tubular feed well 35 terminates short of the bottom of the bowl; the latter having a rubber lining 36, smooth except for radial ribs 37 in the bottom portion of said bowl.

A feed spout 38 is mounted in the upper portion of the frame 1 in position to deliver the ore pulp in a stream into the upper end of the tubular feed well 35.

When the apparatus is in use for the purpose of accomplishing classification or rough concentration of the ore pulp, the driven tubular shaft 16 is adjusted so that the space 34 between the upper edge 33 of the bowl and the horizontal top plate 8 is relatively wide, as shown in Fig. 2. Then, with the bowl 25 rotating with the driven tubular shaft 16, the ore pulp feeds in a stream into the tubular feed well 35, and thence into the centrifugal bowl 25, effective agitation being assured by the ribs 37, while the rubber lining 36 presents a smooth but wear-resistant surface.

The heavy fractions and the middlings, of the ore pulp, pass through the space 34 between the upper edge 33 of the bowl and the top plate 8, and—after escaping said edge—turn and descend in the water, in the apparatus, downwardly in the cylindrical upper portion 4 of the tank 3 into the inverted cone 5. The heavy fractions accumulate or concentrate in the lower end of said cone 5, subsequently being removed through the clean-out valve 6. The middlings tend to work in the cone 5 above its lower end, being drawn by the injecting action of the jet nozzle 30 into the extension 28 and thence are force-fed upwardly in the tubular shaft 16. At the upper end of said tubular shaft 16 the water-fed middlings discharge into a top launder 39 supported by a bracket 40, and from said launder such middlings feed through an outlet conduit 41 into a hose 42 which has return communication with the feed spout 38. The middlings are thus recycled through the apparatus, as is desirable to the attainment of efficient concentration of the ore pulp.

The fines which deliver in the ore pulp to the centrifugal bowl 25 from the tubular feed well 35 are maintained in water which overflows through the circular opening 9 into the launder 10, discharging through the outlet spout 14.

By the simple expedient of adjusting the vertical position of the centrifugal bowl 25 to narrow the space 34 between the upper edge 33 of the bowl 25 and the top plate 8, a finer degree of concentration can be accomplished; the bowl being shown in such a position in Fig. 4. Also, when such an adjustment of the bowl is made, the top plate 8 is removed and other top plate 43 replaced; such other top plate having a circular opening 44 of greater diameter than the circular opening 9. The circular opening 44 in such other top plate 43 is only slightly less in diameter than the diameter of the upper edge 33 of the bowl 25.

The relatively narrow space between the upper edge 33 of the bowl 25 and the top plate 43, as in Fig. 4, is indicated at 45.

With the concentrator adjusted as in Fig. 4, the fines or lighter fractions, together with the middlings, are carried in the overflow water through the circular opening 44 into the launder 10, discharging as before.

The heavier fractions or concentrates pass over the upper edge 33 of the bowl 25 between the space 45, and thence flow downwardly in the cylindrical upper portion 4 of the tank 3, concentrating—as before—in the bottom of the cone 5.

Under certain conditions, the recycling of the middlings may not be necessary or desirable. In such cases, the jet nozzle 30 and the extension 28 are removed and a cap 46 is threaded onto the lower end of the tubular shaft 16; water to produce the desired up-flow in the tank 3 then being delivered directly out of the upper end of the standpipe 29 without jet action. This water is preferably fed into the tank as close to the bottom of bowl 25 as possible, as shown in Fig. 4, so as not to disturb the normal action in the lower portion of cone 5. This water feeding action has been found to be particularly effective when the apparatus is adjusted for classification purposes, as shown in Fig. 2.

With the described apparatus, concentration or classification of water pulp ore can be processed to selective extent, depending on the nature of the ore and related working conditions. The apparatus is economical in operation, has high daily capacity, and yet is most effective in its recovery of concentrates.

From the foregoing description it will be readily seen that there has been produced such a concentrator as will substantially fulfill the objects of the invention, as set forth herein.

While this specification sets forth in detail the present and preferred construction of the concentrator, still in practice such deviations therefrom may be resorted to as do not form a departure from the spirit of the invention as defined by the appended claims.

Having thus described the invention, the following is claimed as new and useful, and upon which Letters Patent are desired:

1. A concentrator comprising a frame-supported tank circular in plan at the upper portion, a vertical-axis centrifugal bowl, means mounting the bowl concentrically and for rotation in the tank, the bowl at its upper edge

being circular, of less diameter than said upper portion of the tank, and said edge running in a plane below the corresponding edge of said tank; a top plate on the tank having a central circular opening therein, means to feed ore pulp into the bowl from above, a launder surrounding the upper portion of the tank in position to receive overflow from said opening; the bowl mounting means including means to adjust said bowl vertically whereby to alter the spacing between the upper edge of the bowl and the top plate on the tank, the opening in the top plate being of less diameter than the bowl at its upper edge, and means to feed water into the tank with an upflow from below the bowl.

2. A concentrator comprising a frame-supported tank circular in plan at the upper portion, a vertical-axis centrifugal bowl, means mounting the bowl concentrically and for rotation in the tank, the bowl at its upper edge being circular, of less diameter than said upper portion of the tank, and said edge running in a plane below the corresponding edge of said tank; a top plate on the tank having a central circular opening therein, means to feed ore pulp into the bowl from above, a launder surrounding the upper portion of the tank in position to receive overflow from said opening, a tubular member projecting from above axially downward through the bowl into the tank to an open termination therein above its bottom, a jet nozzle directed upwardly into the lower end of said tubular member, means to supply water to said jet nozzle, and conduit means connected between the upper end of said tubular member and the means supplying ore pulp to the bowl.

3. A concentrator comprising a frame-supported tank cylindrical at its upper portion and an inverted cone therebelow, a vertical-axis semi-spherical centrifugal bowl of lesser diameter than and disposed concentrically in said upper portion of the tank, a vertical shaft journaled on the frame and depending into the tank axially thereof, the bowl being secured to the shaft, power means to drive the latter, the upper edge of the bowl running in a plane below the corresponding edge of the tank, a top plate on the tank having a central circular opening therein of less diameter than said bowl at its upper edge, means to feed ore pulp into the bowl from above, a launder surrounding the upper portion of the tank in position to receive overflow from said opening, and means to cause an upflow of he pulp in the tank.

4. A concentrator, as in claim 3, in which the bowl is vertically adjustable on the shaft.

5. A concentrator comprising a frame supported tank cylindrical at its upper portion and an inverted cone therebelow, a vertical-axis semi-spherical centrifugal bowl of lesser diameter than and disposed concentrically in said upper portion of the tank, a vertical shaft journaled on the frame and depending into the tank axially thereof, the bowl being secured to the shaft, the shaft being tubular and terminating at its lower end below the bowl but above the

bottom of the tank and open to the latter, a water jet nozzle projecting vertically into the lower end of said tubular shaft, power means to drive the latter, the upper edge of the bowl running in a plane below the corresponding edge of the tank, a top plate on the tank having a central circular opening therein of less diameter than said bowl at its upper edge, means to feed ore pulp into the bowl from above, conduit means between the upper end of the shaft and said feeding means, and a launder surrounding the upper portion of the tank in position to receive overflow from said opening.

6. A concentrator comprising a frame-supported tank cylindrical at its upper portion and an inverted cone therebelow, a vertical-axis semi-spherical centrifugal bowl of lesser diameter than, and disposed concentrically in, said upper portion of the tank, a tubular vertical shaft journaled on the frame above the bowl and depending into the tank axially thereof through the bowl and open at its lower and to the tank, the bowl being secured to the shaft, a water jet nozzle projecting vertically into the lower end of the tubular shaft, a pulley on the tubular shaft adjacent but below its upper end, means to drive said pulley, a top plate on the tank having a central circular opening therein of less diameter than the diameter of the bowl at its upper edge, said upper edge of the bowl running in adjacent but spaced relation below said plate, a vertical tubular feed well fixed in the frame and depending into the bowl in surrounding relation to the tubular shaft, an ore pulp feed spout positioned to deliver into said feed well, a launder surrounding the upper portion of the tank in position to receive overflow from said opening in the top plate, a separate launder associated with the tubular shaft at its upper end above said pulley, and conduit means between said separate launder and the feed spout.

7. A concentrator, as in claim 1, with means removably mounting the top plate on the tank whereby plates having circular openings of different sizes may be selectively mounted on the tank.

8. A concentrator, as in claim 5, in which the lower portion of the tubular shaft is removable, there being a depending water supply conduit on which the nozzle is removably mounted at a level such that when said lower shaft portion and the nozzle are removed a horizontal space is left between the adjacent ends of the shaft and conduit.

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