No. 865,542. PATENTED SEPT. 10, 1907.

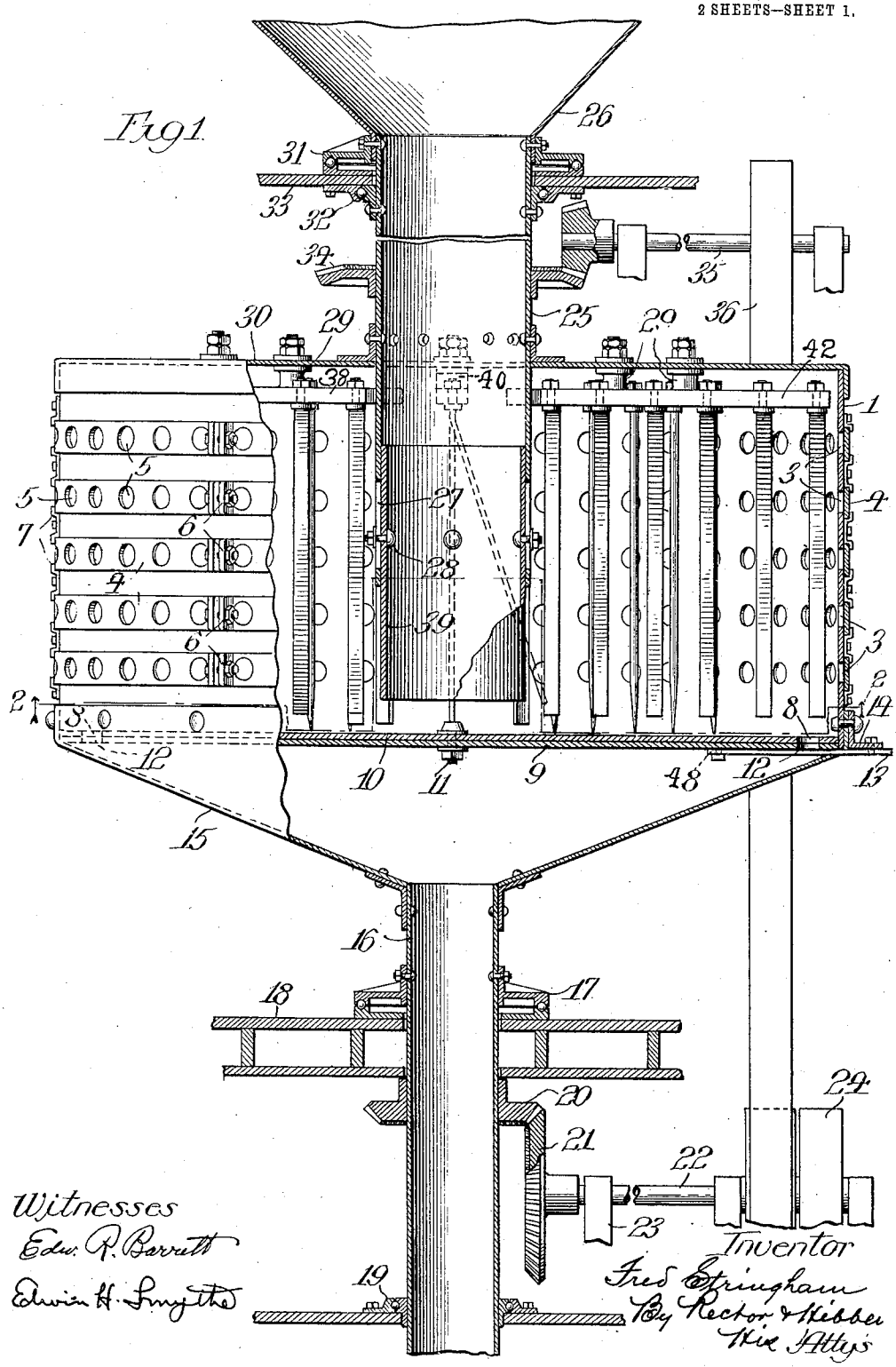
F. STRINGHAM.

SEPARATING MACHINE.

APPLICATION FILED NOV. 7, 1905.

2 SHEETS—SHEET 1.

Fig 1.



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2 SHEETS—SHEET 2.

Fig. 2.

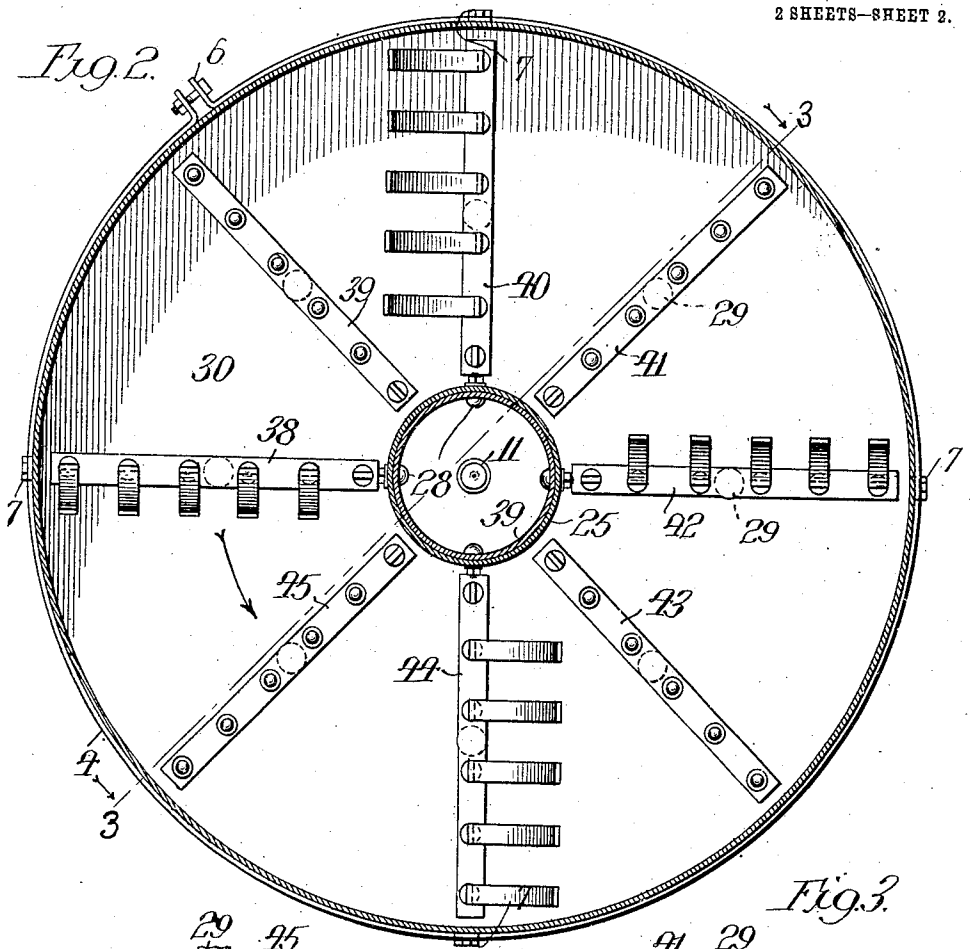
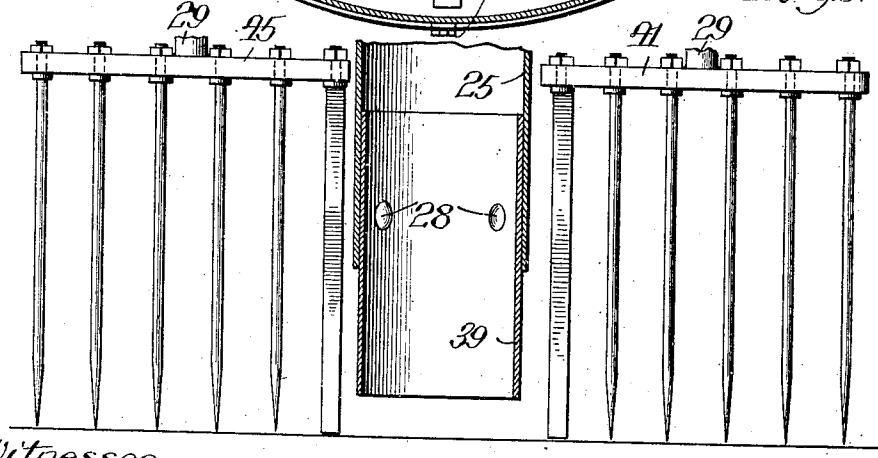


Fig. 3.



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FRED STRINGHAM, OF MANITOU, COLORADO.

SEPARATING-MACHINE.

No. 865,542. Specification of Letters Patent. Patented Sept. 10, 1907.

Application filed November 7, 1905. Serial No. 286,284.

To all whom it may concern:

Be it known that I, FRED STRINGHAM, a citizen of the United States, residing at Manitou, in the county of El Paso and State of Colorado, have invented certain new and useful Improvements in Separating-Machines, of which the following is a specification.

My invention relates to a machine for treating mixed substances of different specific gravities in a comminuted condition to separate the substances from each other, and relates more particularly to a machine for treating metalliferous ores or earths in order to separate the heavy or valuable from the lighter or base portions.

The machine of my invention is of that class commonly termed ore-concentrators, and depends for its operation upon that property which leads to the heavier or metallic portions of ore in a finely divided condition settling to the bottom, and the lighter or earthy portions rising when the comminuted mass is agitated and worked.

My principal object is to provide a machine which shall be simple and inexpensive in its construction and efficient in its operation, and which shall permit the concentration of the ore to be carried on as a continuous process, with a greater degree of rapidity than has been obtainable heretofore, and with a higher degree of recovery of the values or concentrates. This, generally speaking, I accomplish by constructing the machine so that the sand, or crushed and comminuted ore is fed to the rotating concentrating receptacle of the machine at its center and bottom, and below the surface of the material undergoing concentration, from which point it is automatically fed and carried outwardly by the rotation of the receptacle and at the same time is worked and concentrated, the lighter waste portion being worked upwardly by stirring mechanism preferably rotating in the opposite direction to the direction of rotation of the receptacle, and finally being permitted to escape through openings or ports suitably arranged in the upper portion of the wall of the receptacle, while the concentrates or values settle and escape through openings in the bottom of the receptacle.

The machine of my invention comprises various other features of novelty, among which may be mentioned the construction whereby the feed tube serves as a shaft to cause the rotation of the stirring mechanism, while the delivery tube acts as a shaft to cause the rotation of the concentrating receptacle or barrel, the adjustable arrangement of the openings or ports through which the waste and the concentrates escape, whereby the degree of concentration may be regulated; the adjustable arrangement of the feed tube; the peculiar construction and disposition of the stirring mechanism; and other novel features, which will be described in the following specification and particularly pointed out in the appended claims.

Referring to the drawings, Figure 1 is a front elevation, partially broken away and in section, of a concentrating machine embodying the novel features of my invention; Fig. 2 is a sectional plan view of the machine on line 2—2 of Fig. 1, looking towards the top; and Fig. 3 is an elevation of the stirring mechanism on line 3—3 of Fig. 2.

Like parts in the several views are designated by the same reference characters.

The machine as illustrated, comprises a receptacle or barrel 1 within which the concentration of the material to be treated is adapted to take place. This receptacle or barrel which may be of any convenient size and shape, and which may be constructed of any suitable material, as iron or wood, is provided preferably with several series of openings 3 in its side walls, through which the lighter or waste material is allowed to escape. The several series are preferably arranged about the periphery of the receptacle or barrel at different distances from the bottom, and are provided with means for opening and closing any particular series at will, comprising, in the present instance, a ring or band 4 encircling each series of openings and having in it holes 5 adapted to register with the openings in the wall of the barrel. Each band is arranged so that it may be moved or rotated about the barrel to bring the openings in it and in the barrel into or out of register, so that the size of the passage through them may be adjusted. Each band is also provided with suitable means, as a bolt 6 passing through its upturned ends, by means of which it may be clamped in any position to which it is adjusted. The bands are held against all movement excepting their rotary movement of adjustment by the lugs 7 secured to the wall of the barrel or receptacle. As many series of openings as desired may be provided, five being shown in the present instance.

To permit the escape of the concentrates from the barrel, a series of openings 8 is provided in the bottom of the barrel near its outer edge, for which an adjustable closure is provided in the form of a disk 9 pivoted at the center of the bottom 10 of the barrel and having openings 12 in its periphery corresponding with the openings 8 in the bottom of the barrel. A handle or lever 13 pivoted to the lug 14 secured to the outer wall of the barrel extends from the disk 9 into position where it is accessible from the outside of the machine, and by means of this lever the disk may be rotated with respect to the bottom of the barrel to bring the holes 8 and 12 into or out of register, to regulate the size of the passage through them. Play between the lever 13 and disk 9 is provided for by joining them through the medium of a pin and slot connection 48. The collection of the values or concentrates, which escape from the barrel by way of the holes 8 in the bottom thereof is accomplished, in the present instance, by providing an inverted-conical or hopper-shaped part

15, which embraces and is rigidly secured to the bottom of the barrel, and which tapers to a hollow shaft 16, firmly secured to the hopper, as shown. The hollow shaft 16, through which the concentrates are conducted away, serves also as a medium through which rotation is imparted to the barrel or receptacle 1, and to this end, is provided with bearings, and a suitable connection with a source of power. The bearings, in the present instance, comprise the thrust bearing 17, one member of which is formed in a collar rigidly secured to the hollow shaft 16, while the other member is supported on a suitable framework 18, and a lateral bearing 19, one member of which is secured to the shaft while the other is mounted on a suitable support.

The mechanism for transmitting power to the shaft comprises, in the present instance, a bevel or miter gear consisting of a member 20 carried as a sleeve on the shaft 16, and a member 21 mounted on the end of a shaft 22 suitably supported in bearings 23 and adapted to receive power from any convenient source by way of the pulley 24.

The novel mechanism which I have devised for conveying the material to be concentrated to the barrel 1, comprises a feed pipe or tube 25 preferably terminating at its upper end in a hopper 26, into which the sand or comminuted material may be permitted to run, and with its lower end extending into the center of the barrel or receptacle, and terminating at a short distance from the bottom thereof. In order to render adjustable the opening at the bottom of the feed tube 25, I preferably provide at the end of the tube an extension sleeve 39 adapted to be moved longitudinally upon or within the feed tube, and to be clamped in any position to which it has been adjusted. This I accomplish in the present instance, by providing longitudinal slots 27 at the end of the feed tube 25, in which clamping bolts 28 are adapted to slide.

The concentration of the sand or comminuted material delivered to the barrel through the feed pipe 25 is accomplished through the medium of working and concentrating mechanism which comprises, in the present instance, a number of forks or groups of stirring rods adapted to move in the annular space between the feed tube and the inner wall of the barrel, and to stir and work the material. It will be obvious that as many of these stirring forks as desired may be employed. In the present machine, I have shown eight arranged at equal distances from each other within the barrel, and supported from a disk 30 which extends over and serves as a cover for the barrel, but which is not secured thereto.

I have found it desirable to give the stirring forks or rods a movement of rotation in the opposite direction from that of the barrel, and as a convenient means to that end I rigidly secure the disk or cover 30, to which they are attached, to the feed tube 25, as shown, and arrange the tube so that it serves also as a shaft for the transmission of power to effect the rotary movement of the forks. It will, of course, be understood that the movement of rotation may be imparted to the forks in other manners than through the medium of the cover of the barrel and the feed pipe, without departing from the spirit of my invention. I find it convenient, however, to employ the particular construction illustrated, which consists, in addition to securing the stirring forks to the movable cover of the barrel and it to the feed tube 25, in arranging said tube for rotation by providing it with end and cross thrust bearings 31 and 32, respectively, one member of each of which is secured to the feed tube, while the other is arranged upon a suitable support 33; and in providing it with a miter or bevel gear, one of the members 34 of which is secured as a collar on the feed tube, while the other is carried on the end of a suitably supported shaft 35, the other end of the shaft being in communication through the medium of the pulley 36 with a suitable source of power.

As heretofore stated, the stirring forks in the present instance are eight in number, and are indicated by the reference numerals 38, 39, 40, 41, 42, 43, 44 and 45. Each of these forks comprises a head or cross-piece having a centrally located stem 29 securing it to the top of the barrel, and a number of stirring rods or tines depending from the head. I have found that six tines is a convenient number to employ in connection with each fork, and I have also found that a higher degree of concentration can be secured when the tines are varied in length and in shape. In the present instance, as illustrated, the forks 38 and 42 are each provided with six flat blunt ended tines, which may extend to within say one inch of the bottom of the barrel. The forks 45 and 41 each have six tines, the inner tine of each fork being flat, while the five remaining tines are preferably round in cross-section and pointed as shown in Fig. 3. As illustrated, the tines of these forks extend as closely as possible to the bottom of the barrel, the separation being just sufficient to insure clearance. The forks 44 and 40 are each provided with six flat tines similar to the tines of the forks 38 and 42, excepting that they do not extend quite so near to the bottom of the barrel, the separation being, say, two inches instead of one inch.

The forks 43 and 39 are each provided with six tines, one flat and the others round and pointed, the arrangement being the same as in forks 45 and 41. By this arrangement the flat and blunt tined forks alternate with the round and sharp tined forks, the flat tines serving to work and raise the lighter or base portions of the sand in the upper part of the barrel, while the round sharp tines work the bottom layer of concentrates without raising any of the values into the upper portion of the barrel where they may be mixed with the waste and lost.

I find that at times it is advantageous to turn the flat tines of the forks about their longitudinal axes so that their surfaces may be inclined instead of flat with respect to their direction of rotation about the barrel, and to this end I mount them in their cross-heads so that their angle may readily be varied. Thus, for instance, the outer five teeth of forks 40 and 44 may be inclined, so that in encountering the sand they will throw it towards the center of the barrel, while the tines of forks 38 and 42 may be arranged to throw the sand towards the circumference of the barrel in order more thoroughly to agitate and work it. Or, if desired, the angle of all of the teeth may be adjusted so as to cause them to throw the sand which they encounter either towards the circumference of the barrel, as in working wet, slimy sand, or toward the feed tube, as in working dry sand, where it is desirable to partially counteract the centrifugal force of rotation. It will be observed that the tine of each fork nearest the feed tube 25 is flat and is al-

lowed to extend straight down, and that the face of each of these tines is arranged at right angles to its direction of movement, although its angle may, if desired, be varied, as in the case of the outer tines.

The operation of the machine is as follows: The sand or material to be concentrated is fed into the hopper 26 and is conducted by it to the feed tube 25, through which it falls to the bottom of the concentrating barrel or receptacle 1. When the extension sleeve 26 at the bottom of the feed tube is adjusted to allow the proper opening between the tube and the bottom of the barrel, the sand is held at the bottom of the tube, and does not flow to any considerable extent into the barrel. As soon as the barrel is caused to rotate, however, the centrifugal force which is imparted to the sand at the bottom of the feed pipe causes it to spread out over the bottom of the barrel, whereupon more sand is fed through the tube 25 to take its place, and so long as the material is supplied the feed is automatic and continuous. As the sand flows from the bottom of the tube it is encountered by the tines of the stirring forks moving in the opposite direction, which stir and work it, the sharp tines working the lower layer of the material while the flat tines work the upper portions, the lighter or waste portions moving continuously upward, while the values or concentrates move down. By the time the sand is moved to the periphery of the barrel or receptacle its constituents are thoroughly separated, and finally escape, the waste through the holes 3, and the concentrates through the holes 8. The concentrates fall into the hopper 15, down which they slide into the hollow shaft 16 and through it to their point of delivery. The waste portions, after escaping through the openings 3, may be led away in any suitable manner, or may be merely allowed to fall in a heap which may be removed from time to time.

The degree of concentration of the sand may be regulated to a nicety by means of the adjustable closures 4 of the openings 3 in the side wall, and the closure 9 of the openings 8 in the bottom of the barrel. By opening all of the series of openings in the side of the barrel the amount of working that the sand receives and the degree of concentration will be comparatively slight. As one after the other of the lower series of openings is closed, the depth of the sand in the barrel and the amount that it is worked increases, and when all are closed excepting the upper series, the maximum degree of concentration will be effected. Moreover, by adjusting the size of the passages 8 from the bottom of the barrel by means of the adjustable disk 9 the rate at which the concentrates are permitted to escape may be regulated to still further increase the amount of working which the sand in the barrel is adapted to receive before it is permitted to escape.

It will be seen that by virtue of the novel construction which I employ, the feed is entirely independent of the height of the sand in the barrel, the level of the sand undergoing concentration being, in practice, sometimes as much as a foot above the point at which the sand is delivered into the barrel. The delivery of the sand to the bottom and center of the concentrating receptacle not only results in all the sand receiving a uniform treatment, but also in its being exposed to the action of the working and concentrating mechanism for the maximum length of time, while it is moving upwards and outwards to the ports where it finally escapes from the machine. Moreover, the rapid movement of the teeth of the stirring mechanism through the sand results in a scouring action which assists in freeing the metallic particles, as of "rusty" gold, from the particles of quartz to which they are attached. It will also be seen that my machine is equally well adapted to treat material either in the wet or dry condition.

I claim:

1. In an ore-concentrator, the combination with a barrel or receptacle and means for rotating the same, of a feed tube extending to within a short distance of the bottom of said barrel at the center thereof, a plurality of stirring arms extending from the top of said barrel, and means for moving said arms to work and separate the ore, said barrel having a series of openings in the bottom to permit the passage of the concentrates, and another series disposed circumferentially about the side through which the waste material is adapted to escape.

2. In an ore concentrator, the combination of a barrel or receptacle arranged to continuously discharge the heavier material by gravity and adapted to receive the material to be treated, a rotatable feed tube extending axially of said barrel to within a short distance of the bottom thereof to permit the material to automatically feed into the barrel according to the rate of discharge therefrom, a series of stirring arms mounted upon and carried by said feed tube and adapted to work the material in the barrel, and means for rotating the barrel and feed tube.

3. In an ore concentrator, the combination with a concentrating disk or platform adapted for rotation and arranged to continuously discharge the heavier material by gravity, of a feed tube extending axially of said disk from a source of supply of material to be concentrated to a short distance from the surface of said disk or platform, means for rotating said disk to cause the material to flow from the mouth of said tube, and stirring arms adapted to work and concentrate the material carried on said disk.

4. In an ore-concentrator, the combination with a barrel adapted for rotation, of a feed tube extending axially of said barrel to within a short distance from the bottom thereof, a series of arms or forks extending into said barrel and adapted to rotate around said feed pipe to work and concentrate the material delivered thereby, and means for imparting a relative movement of rotation to said stirring arms and said barrel, said arms or forks being inclined forwardly in the direction of rotation.

5. In a concentrating machine, the combination, with a receptacle for the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of a feed tube extending centrally of said receptacle to within a short distance of the bottom thereof and adapted to supply the material thereto, stirring arms located in said receptacle between the feed tube and the walls of said receptacle and arranged to work the material outwardly and upwardly, and means for rotating the receptacle and stirring arms in opposite directions.

6. In an ore concentrator, the combination of a rotatable receptacle for the material to be concentrated, said receptacle being provided with a plurality of series of openings, one series being arranged in the bottom of the receptacle for the continuous discharge of the heavier material or concentrates by gravity and the other series in the sides of the receptacle for the discharge or escape of the lighter or waste material, and a rotatable feed tube extending centrally of the receptacle for feeding the material thereto, and means operated by the feed tube for working the waste material toward the last mentioned series of openings and the concentrates toward the first mentioned series of openings.

7. In an ore-concentrator, the combination with a barrel for the material to be concentrated, of a rotatable feed tube extending axially of said barrel to within a short distance of its bottom, a series of forks connected with said feed tube and extending down into said barrel, said barrel having openings therein to allow the separate escape of the concentrates and the waste material, and means for causing said feed tube and said barrel to rotate at differ-

ent rates, whereby the material flows out of the feed tube into the barrel and is there worked and concentrated by said forks.

8. In an ore-concentrator, the combination with a rotatable receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of means for feeding the material to said receptacle, means for working and concentrating the material within said receptacle, said receptacle being provided with a series of circumferentially disposed openings in the walls thereof, and means for adjusting the size of said openings, whereby the degree of concentration may be regulated.

9. In an ore-concentrator, the combination with a barrel for the material to be concentrated, of means for supplying the material to the bottom of the barrel and approximately at the center thereof, and forks adapted to rotate within said barrel and axially of the same to work and concentrate the material therein, certain of said forks being provided with tines having blunt ends and others being provided with tines having sharp pointed ends, the blunt ended tines terminating at some distance from the bottom of said barrel, and being adapted to work the upper portions of the material, and the sharp pointed tines just clearing the bottom of the barrel and being adapted to work the lower layer of the material.

10. In an ore-concentrator, the combination with a receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of means for delivering said material to the bottom of said receptacle at approximately the center thereof, said receptacle being provided with lower and upper openings adapted to permit the independent escape therefrom of the concentrates and of the waste material, means for rotating said receptacle to cause a movement of the material from the center to the periphery of said receptacle, and stirring arms for working the material and causing an upward movement of the waste portion thereof during the aforesaid outward movement.

11. In an ore-concentrator, the combination with a rotatable receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of means for feeding the material to said receptacle, means for working and concentrating the material within said receptacle, said receptacle having a plurality of series of openings arranged circumferentially at varying distances from the bottom of the receptacle, and means for opening or closing at will any one or more of said series of openings, whereby the degree of concentration may be regulated.

12. In an ore-concentrator, the combination with a concentrating barrel, of a feed pipe extending axially of said barrel to within a short distance of the bottom thereof, a series of forks adapted to stir the material within said barrel, a series of openings in the wall of said barrel adapted to permit the escape of the waste material, other openings in the bottom of the barrel near the periphery thereof to permit the escape of the concentrates, a disk rotatably secured to the bottom of the barrel and having holes therein registering with the openings in the bottom of the barrel, whereby the extent of said openings may be regulated by turning said disk, and means for relatively rotating said barrel and stirring forks to concentrate the material in the barrel.

13. In an ore-concentrator, the combination with a barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of means for supplying the material to the bottom of the barrel at approximately the center thereof, and forks adapted to rotate within said barrel and axially of the same to work and concentrate the material therein, the tines of one of said forks being arranged to extend closer to the bottom of the barrel than the tines of another fork.

14. In an ore-concentrator, the combination with a barrel or receptacle for the material to be concentrated, of means for continuously supplying the material to the barrel, means acting within the barrel to work and concentrate the material, said barrel being provided with a series of substantially equal apertures in substantially the same horizontal plane about the circumference thereof for the escape of the waste material, and means for simultaneously opening or closing all of said apertures to the same degree, whereby the escape of the waste material is evenly distributed about the circumference of the barrel.

15. In an ore-concentrator, the combination with a rotatable barrel or receptacle for the material to be concentrated, said barrel being provided with openings therein to permit the independent escape of the concentrates and the waste material, of a feed tube extending axially into the barrel and adapted to convey the material to be concentrated to the center of the bottom of the barrel, a top or cover for the barrel rigidly secured to said pipe, stirring arms secured to said cover or top and extending into the barrel, and means for causing a relative rotation of said feed pipe with its associated stirring arms and said barrel.

16. In an ore-concentrator, the combination with a barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, said receptacle having openings in the periphery of the bottom thereof to permit the escape of the concentrates, of means for feeding the material to be concentrated to said receptacle, stirring arms or forks extending into said receptacle and adapted to work and concentrate the material therein, a delivery tube extending axially from the bottom of the receptacle and rigidly secured thereto, and adapted to support the receptacle, said delivery tube being in communication with the openings from said receptacle for permitting the passage of the concentrates, and means for effecting rotation of said delivery tube to rotate the receptacle and thereby effect the concentration of the material therein.

17. In an ore-concentrator, the combination with a barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, said receptacle being provided with openings for the independent passage therefrom of the concentrates and the waste material, a feed tube extending axially into said receptacle to within a short distance of the bottom thereof, stirring arms connected with said tube and extending into the receptacle, a delivery tube extending axially from the barrel and rigidly connected with the bottom thereof, said delivery tube being in communication with the openings for permitting the escape of the concentrates, and means adapted independently to rotate the feed tube with its associated stirring arms, and the delivery tube with its associated receptacle.

18. In an ore-concentrator, the combination with a barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, said barrel being provided with openings therein to permit the independent escape of the concentrates and the waste material, of a feed tube extending axially into the barrel to a short distance from the bottom thereof, stirring arms connected with said feed tube and extending into the barrel, and means for causing the independent rotation of said feed pipe with its connected stirring arms and said barrel.

19. In an ore-concentrator, the combination with a receptacle for the material to be concentrated, of means for effecting the rotation of said receptacle, a feed tube extending to within a short distance of the center of rotation of the receptacle, stirring forks provided with flat-faced tines adapted to be turned about their longitudinal axes to vary the engaging angle of the tine faces, and means for adjusting the separation between the feed tube and the receptacle, whereby the rapidity of feed may be regulated.

20. In an ore-concentrator, the combination with a barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, said barrel being provided with openings therein to permit the independent escape of the concentrates and the waste material, of a feed tube extending axially into the barrel, an adjustable extension sleeve on the end of said feed tube, whereby the opening between the end of the feed tube and the bottom of the receptacle may be regulated, means for regulating the rate

of escape of the concentrates, and means for causing the rotation of said receptacle or barrel.

21. In an ore-concentrator, the combination with a rotatable barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of a rotatable feed tube for continuously supplying the material to the bottom of the receptacle at approximately the center thereof, and forks secured to said tube and adapted to rotate within in a direction opposite to that of said receptacle and axially of the same to work and concentrate the material therein, said forks being provided with flat faced and blunt-ended tines adapted to be turned about their longitudinal axes, whereby the engaging angle of the faces of the tines may be varied, and with a series of sharp-pointed tines alternating with said other tines.

22. In an ore-concentrator, the combination with a rotatable barrel or receptacle adapted to receive the material to be concentrated and arranged to continuously discharge the heavier material by gravity, of means for continuously supplying the material to the bottom of the receptacle at approximately the center thereof, and forks adapted to rotate within in a direction opposite to that of said barrel and axially of the same to work and concentrate the material therein, said forks being provided with flat-faced, blunt-ended tines and also with sharp pointed tines just clearing the bottom of the barrel and adapted to work the lower layer of material without raising the values therein into the upper portion of the material.

23. In an ore concentrator, the combination of a rotatable barrel or receptacle for the material to be concentrated and having means for discharging the heavier material by gravity, means for supplying the material to the barrel or receptacle consisting of a central feed tube extending therein to within a short distance of the bottom, and the series of stirring devices operating within and rotating in a direction opposite that of said barrel or receptacle and comprising arms or tines of different construction and length, some of said arms extending closer to the bottom than others and some of the arms being shaped or formed different from the others, and arranged in alternating series, for the proper treatment of the waste material and the concentrates.

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