Jan. 22, 1935. B. B. WALTMAN 1,988,528

CENTRIFUGAL AMALGAMATOR

Filed Dec. 26, 1933

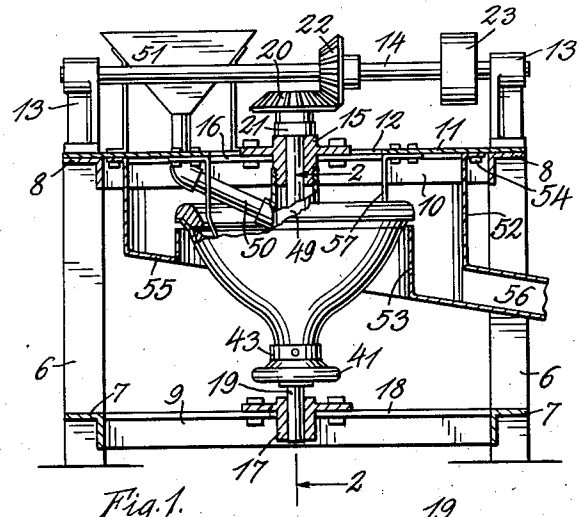


Fig. 1.

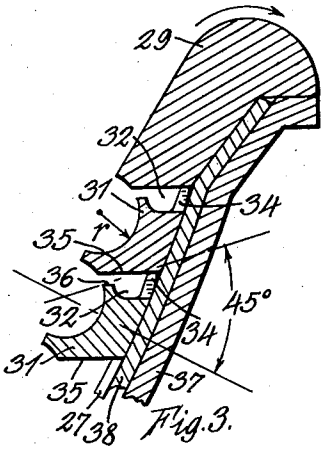


Fig. 3.

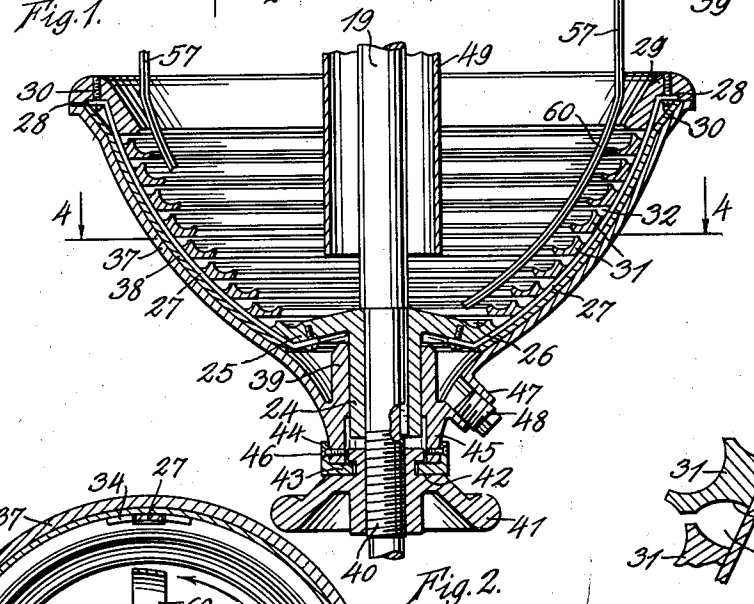


Fig. 2.

Fig. 5.

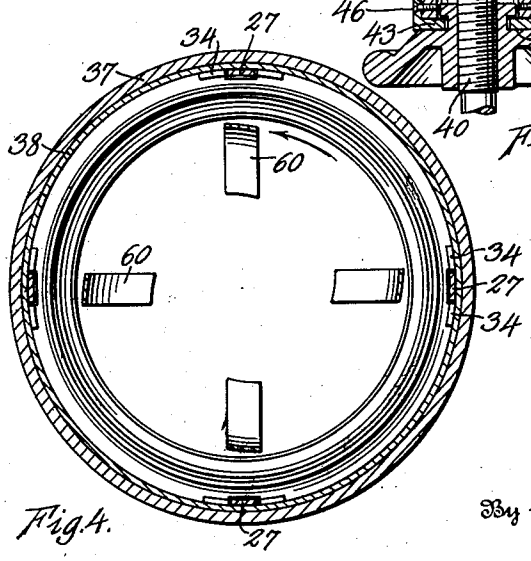


Fig. 4.

Inventor

Burton B. Waltman.

By A. J. O'Brien

Attorney

Patented Jan. 22, 1935 1,988,528

UNITED STATES PATENT OFFICE

1,988,528

CENTRIFUGAL AMALGAMATOR

Burton B. Waltman, Denver, Colo., assignor of one-fourth to James Ernest Higson and one-fourth to Fred S. Cass, both of Denver, Colo., and one-fourth to John J. Cody, Lockwood, Colo.

Application December 26, 1933, Serial No. 703,922

9 Claims. (Cl. 209—199)

This invention relates to improvements in centrifugal ore separators and has reference more particularly to the construction of the rotating bowl in which the separation takes place.

In the recovery of precious metals, such as gold from pulp or from placer sand and gravel, it is customary to employ a centrifugal device comprising a bowl that is open at its top and whose sides are provided with a plurality of grooves or riffles. The pulp is introduced into the bowl near its bottom and the bowl is also provided with a quantity of mercury. When the bowl is rotated at a high speed the mercury will distribute itself along the sides of the bowl and when the pulp enters the bowl and attains a high rotary speed, the centrifugal force acting differentially on the different constituents of the pulp will produce forces that tend to move the denser particles towards the outside and into contact with the mercury. When the metal to be separated is gold, this is very dense compared to the gangue and therefore a larger differential action takes place than when gravity alone is depended on. When mercury is employed in connection with the separation, the gold will amalgamate with the mercury and can be removed in the ordinary manner.

It has been found that centrifugal bowls provided with grooves in their inner surfaces are very difficult to clean and that the grooves fill up very rapidly, making it necessary to stop the machine frequently for cleaning.

It is an object of this invention to produce a centrifugal bowl of such construction that it can be easily and quickly cleaned, and which will also function for a longer time than the ordinary bowl without being cleaned, and in this way a great saving of time is effected, thereby increasing the capacity per machine.

This invention, briefly described, consists of a bowl formed in part by a hub-like member, that is secured to a vertical shaft and provided with an outwardly extending flange. Secured to the flange and projecting outwardly and upwardly therefrom are a plurality of supporting arms whose upper ends are attached to a clamping ring. A plurality of rings of different diameters are supported on the arms and held in spaced relation by suitable spacers and the assembly is held in operative position by means of the clamping ring. A bowl of imperforate material is secured to the shaft and is of such size and shape that it can be moved upwardly against the outer surface of the ring assembly for the purpose of closing the bottoms of the openings between the rings. When the machine is operating, the concentrates will accumulate in the spaces between the rings, and when the bowl is to be cleaned, the outer bowl is dropped, thereby removing it from sealing contact and permitting the contents of the grooves to be washed out by means of a water spray.

Another object of this invention is to produce a bowl having an inner surface comprising a plurality of grooves of substantially semi-circular shape which communicate with the spaces between the rings and serve to set up currents in the pulp that facilitate the separation of the values therefrom.

The above and other objects that may become apparent as this description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail, and reference for this purpose will now be had to the accompanying drawing in which the preferred embodiment of the invention has been illustrated, and in which:

Fig. 1 is a transverse vertical section of the improved machine;

Fig. 2 is a transverse diametrical section of the bowl;

Fig. 3 is a section through the upper edge of the bowl showing the parts in substantially full size;

Fig. 4 is a section taken on line 4—4, Fig. 2; and

Fig. 5 is another section through a side of the bowl showing a slightly modified construction.

In the drawing reference numerals 6 designate vertical end members of a supporting frame. There are preferably four end members and the two side members are connected at their lower ends by means of angle irons 7 and at their upper ends by similar angle irons which have been designated by reference numerals 8. The two end posts at each end are connected by means of transverse angle irons 9 which are located at the bottom and similar angle irons 10 located at the top. Supported on the top of the frame is a steel plate 11 that is provided at its center with a circular opening 12. The outer dimensions of plate 11 may be the same as the outer dimensions of the frame, as shown in Fig. 1. Extending upwardly from the top of the plate 11 and secured to the frame members 8 are bearing blocks 13 in which the shaft 14 is journaled.

The bearing 15 is supported from the plate 11 by means of bars 16 and this bearing is located approximately at the center of the opening in the plate. A smaller bearing 17 is supported from the side members 7 by means of supporting members

18. A shaft 19 is journaled in the two bearings 15 and 17 and is provided at its upper end with a bevel gear or pinion 20. An antifriction thrust bearing 21 is located between the under side of the pinion and the upper end of bearing 15. Shaft 14 is provided with a bevel gear or pinion 22 that is in mesh with the gear 20 and is also provided with a pulley 23 by means of which power can be transmitted to the shaft from a suitable prime mover. Secured to the shaft is a hub 24 whose upper end is provided with an outwardly extending flange 25. In the drawing the upper surface of the flange is inclined outwardly and downwardly so as to form a frusto-conical surface. The outer edge of the upper surface of the flange is provided with an annular groove 26. Secured to the under surface of the flange are a plurality of upwardly and outwardly inclined supports or arms 27. The upper surface of each arm is concave and curved approximately as shown in Fig. 2 and the extreme upper ends are bent outwardly, as indicated by reference numeral 28. In the drawing four arms 27 have been shown, but a larger number can be employed, if desired. The upper ends of the supporting arms have secured to them a ring 29 that is fastened by means of screws 30. The bowl assembly is formed from a plurality of separate and independent rings 31 of progressively larger size from the bottom upwardly. These rings are of the general shape shown in Fig. 3, from which it will be seen the inner surface is curved on a radius *r*. The upper wall of each ring is cut away so as to form a recess 32. Extending upwardly from the bottom of each recess are spacing lugs 34 of which one is preferably located on each side of each supporting arm 27 in the manner shown in Fig. 4. The spacing lugs are longer than the depth of the recess and therefore when the rings are assembled, the bottom surface 35 of each ring will be located a short distance above the upper edge 36 of the ring directly beneath, whereby an opening is formed leading into the recess. After the rings have been assembled, they are clamped together by means of the screws 30. It will be obvious that unless some means is provided for sealing the ring assembly at the back, the pulp will flow outwardly through the openings and in order to prevent this an imperforate bowl 37 is provided which has the same general shape on its inner surface as the outer surface of the ring assembly and the bowl is also lined with a sheet 38, preferably of rubber, so that when it is moved into position, the rubber will engage the outer surfaces of the rings and form a back wall for the recesses as shown in Fig. 3. The bowl 37 has an upwardly extending hub 39 with an axial opening of the proper size to receive the hub 24 and the shaft is provided with a threaded section 40 with which a clamping nut 41 is operatively connected. The clamping nut has an annular groove 42 into which the ring 43 extends. This ring is made in two parts and has a cylindrical flange 44 that extends upwardly and overlaps the downwardly projecting cylindrical flange 45 of the bowl. Screws 46 serve to hold the split ring in place. It is apparent that when the nut 41 is rotated, it will move the bowl 37 either upwardly towards the ring assembly, or downwardly away from the same. When the parts are in operative position, the imperforate bowl is moved upwardly into the position in Figs. 2 and 3 so as to close the openings between the several rings, but when the bowl is to be cleaned, the imperforate bowl is moved downwardly so as to space the inner surface of the rubber seal away from the rings and this permits the recesses to be cleaned by directing into them a stream of water. The imperforate bowl has a discharge opening 47 that is normally closed by a plug 48. A proper counterbalance for the parts 47 and 48 is provided on the opposite side of the bowl. Secured to the lower end of hub 15 is a tubular member 49 that terminates a short distance above the upper surface of flange 25 and the upper end of this tubular member is connected by means of pipes 50 to a feed hopper 51. The pulp is fed to the hopper 51 and flows downwardly through the pipes 50 and through the annular space between the shaft and the tubular member 49 and is delivered to the bowl near the bottom thereof. When the bowl rotates and pulp is fed at a predetermined rate to the center thereof, this pulp will assume the speed of rotation of the bowl and will flow upwardly along the inner surface of the ring assembly. The centrifugal force due to the rotation will act upon the several particles in proportion to their mass or density and the heavy particles will be moved outwardly towards the inner surface of the bowl and will pass through the openings between the rings and into the recesses where the gold and other heavier materials will accumulate. The peculiar configuration of the inner surface of the ring assembly produces streams of pulp that pass along the arcuate inner surfaces of the rings and in which the gold values are located on the outside of the stream and when this pulp passes the openings that lead into the recesses, the heavier particles will move into the recesses and remain there while the lighter particles will rejoin the pulp stream and ultimately overflow the bowl in the direction of the arrow in Fig. 3. Surrounding the bowl is a launder having an outer wall 52 and an inner wall 53. The upper end of the outer wall is connected with the support plate by means of bolts 54. The lower ends of the walls are connected by a bottom 55 and at the lowest point of the bottom the launder is connected with a discharge pipe 56. In order to facilitate the movement of the material towards the inner surface of the bowl assembly and to produce certain agitations that assist in the separation, curved bars 57 have their upper ends connected to the under side of the plate 11 by means of bolts 58, which pass through elongated openings 59 in the upper ends of these arms. The lower ends of the arms are curved as indicated at 60 and they are also slightly twisted as shown in Fig. 4. As the pulp moves against the twisted parts 60 of the bars, it is given an outward movement that assists the centrifugal force in producing the separation.

In Fig. 5 a slightly different form of recess has been shown and this differs from that shown in Fig. 3 primarily in this, that the upper ring has a portion of its lower surface cut away as indicated by reference numeral 61. This construction gives a somewhat larger recess that can be more readily cleaned than the recess shown in Fig. 3.

It will be seen from the above description that a bowl constructed in accordance with this invention can be easily cleaned because when the imperforate bowl is moved away from the ring assembly, the outer edges of the recesses become open and it is only necessary then to rotate the bowl slowly and directly against the inner surface thereof a spray of water which loosens the accumulations in the recesses and washes them down into the outer bowl from which they are removed through the opening 47.

Particular attention is called to the construction of the rings and more particularly to the fact that the inner surfaces of the rings form what may be termed circular grooves that force the pulp to move into a peculiar path that has been found to greatly facilitate the separating operation.

Having described the invention what is claimed as new is:

1. A bowl for use with a centrifugal ore separator, comprising, in combination, a central shaft, a flange surrounding the shaft, a plurality of upwardly concave bars, secured at their lower ends to the flange, a plurality of rings supported on the bars, each ring having a plurality of spacing lugs that engage the adjacent ring, the uppermost ring being attached to the upper ends of the straps by bolts which serve as means for clamping the rings in assembled relation, a bowl of imperforate material enclosing the ring assembly, and means for moving the bowl towards and away from the ring assembly.

2. A bowl for use with a centrifugal ore separator, comprising, in combination, a shaft mounted for rotation, a flange carried by the shaft, a plurality of curved supporting bars secured at their lower ends to the flange, said bars being concave on their upper sides, a plurality of rings of different diameters, supported on the bars, the several rings having overlapping sides and spacing lugs, a clamping ring secured to the ends of the curved bars, bolts for securing the clamping ring to the bars and for forcing the rings comprising the assembly into contact, and a bowl of imperforate material surrounding the ring assembly, and in contact with the outer surfaces thereof.

3. A bowl for use with a centrifugal ore separator, comprising, in combination, a shaft mounted for rotation, a flange carried by the shaft, a plurality of curved supporting bars secured at their lower ends to the flange, said bars being concave on their upper sides, a plurality of rings of different diameters, supported on the bars, the several rings having overlapping sides and spacing lugs, a clamping ring secured to the ends of the curved bars, bolts for securing the clamping ring to the bars and for forcing the rings comprising the assembly into contact, a bowl of imperforate material surrounding the ring assembly and in contact with the outer surfaces thereof, and means for adjusting the position of the bowl with respect to the ring assembly.

4. A bowl for use with a centrifugal ore separator, comprising, in combination, a shaft mounted for rotation, a flange carried by the shaft, a plurality of curved supporting bars secured at their lower ends to the flange, said bars being concave on their upper sides, a plurality of rings of different diameters supported on the bars, the several rings having overlapping sides and spacing lugs, a clamping ring secured to the ends of the curved bars, bolts for securing the clamping ring to the bars and for forcing the rings comprising the assembly into contact, a bowl of imperforate material surrounding the ring assembly and in contact with the outer surfaces thereof, and means for adjusting the position of the bowl with respect to the ring assembly, the bowl having a rubber lining for engaging the outside of the ring assembly.

5. A bowl for use with centrifugal ore separators, comprising, in combination, a shaft, a hub secured to the shaft, the hub having an outwardly extending flange, a plurality of supporting bars attached at one end to the flange and extending outwardly at an acute angle with respect to the shaft, a clamping ring secured to the outer ends of the supporting bars, a plurality of rings of different sizes assembled in parallel relation between the outer edge of the flange and the clamping ring, the sizes of the rings conforming to the space between the bars at that particular point, means for spacing the surfaces of adjacent rings to provide an annular recess between each pair of adjacent rings, a bowl of imperforate material having its bottom provided with an axial opening for the reception of the hub on the shaft, a nut threadedly connected with the shaft below the hub, the nut having a circular groove in its surface, and means attached to the bowl and engaging the groove in the nut whereby a rotation of the nut will move the bowl towards and away from the ring assembly.

6. A bowl for use with a centrifugal ore separator, comprising, in combination, a shaft, a hub secured to the shaft, the hub having an outwardly extending flange, a plurality of supporting bars attached at one end to the flange and extending outwardly at an actute angle with respect to the shaft, a clamping ring secured to the outer ends of the supporting bars, a plurality of rings of different sizes assembled in parallel relation between the outer edge of the flange and the clamping ring, the sizes of the rings conforming to the space between the bars at that particular point, means for spacing the surfaces of adjacent rings to provide an annular recess between each pair of adjacent rings, a bowl of imperforate material having its bottom provided with an axial opening for the reception of the hub on the shaft, a nut threadedly connected with the shaft below the hub, the nut having a circular groove in its surface, means attached to the bowl and engaging the groove in the nut whereby a rotation of the nut will move the bowl towards and away from the ring assembly, and a rubber lining for the bowl.

7. A bowl for use with centrifugal ore separators, comprising, in combination, a shaft mounted for rotation about a vertical axis, the shaft having an outwardly extending flange, a plurality of bars secured at their lower ends to the flange and extending upwardly and outwardly therefrom, a plurality of rings of different diameters supported on the bars, means for spacing the adjacent surfaces of the rings to form recesses, the recesses being enlarged towards the outside of the rings, a bowl of imperforate material surrounding the ring assembly and forming an outer wall for the recesses, and means for moving the bowl in the direction of the length of the shaft.

8. A bowl for use with centrifugal ore separators, comprising, in combination, a shaft mounted for rotation about a vertical axis, the shaft having an outwardly extending flange, a plurality of bars secured at their lower ends to the flange and extending upwardly and outwardly therefrom, a plurality of rings of different diameters supported on the bars, means for spacing the adjacent surfaces of the rings to form recesses, the recesses being enlarged towards the outside of the rings, a bowl of imperforate material surrounding the ring assembly and forming an outer wall for the recesses, said bowl having a sheet rubber lining, and means for moving the bowl in the direction of the length of the shaft.

9. A bowl for use with centrifugal ore separators, comprising, in combination, a shaft mounted for rotation about a vertical axis, the shaft

having an outwardly extending flange, a plurality of bars secured at their lower ends to the flange and extending upwardly and outwardly therefrom, a plurality of rings of different diameters supported on the bars, means for spacing the adjacent surfaces of the rings to form recesses, the recesses being enlarged towards the outside of the rings, a bowl of imperforate material surrounding the ring assembly and forming an outer wall for the recesses, and means for moving the bowl relative to the shaft towards the ring assembly and for holding it in sealing position.

BURTON B. WALTMAN.