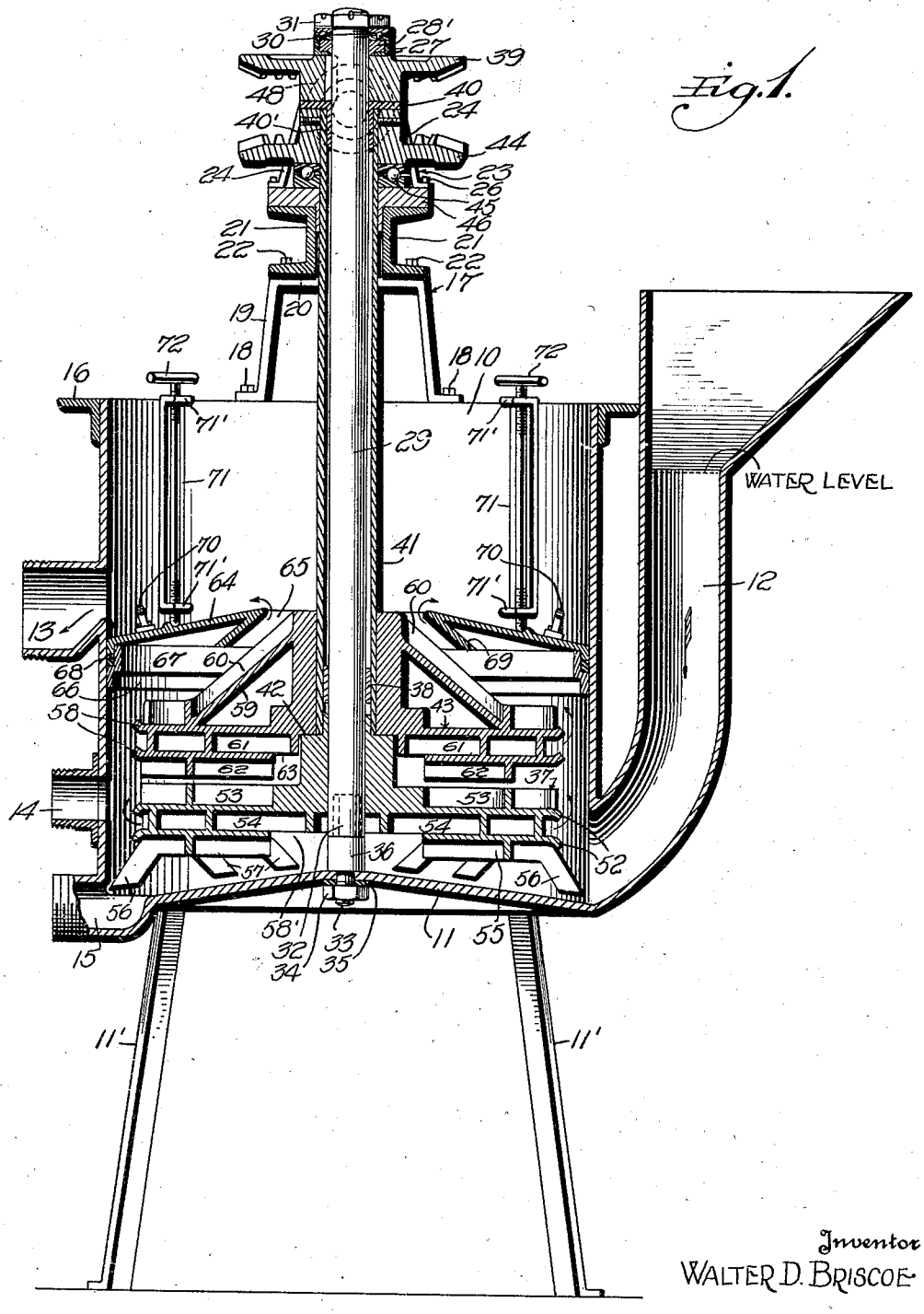
May 29, 1934. W. D. BRISCOE 1,960,726

APPARATUS FOR SEPARATING METALS FROM ORES

Original Filed Jan. 13, 1930 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

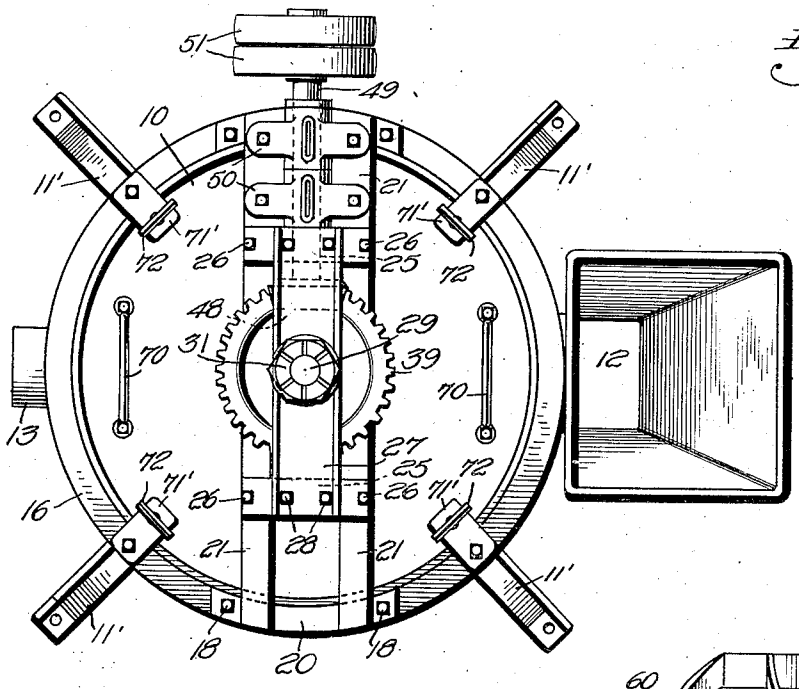


Fig. 3.

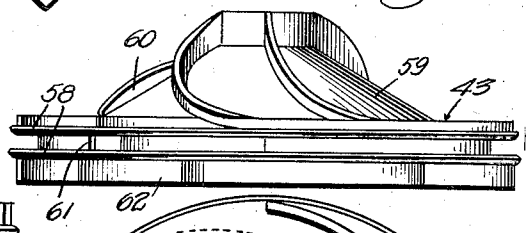


Fig. 6.

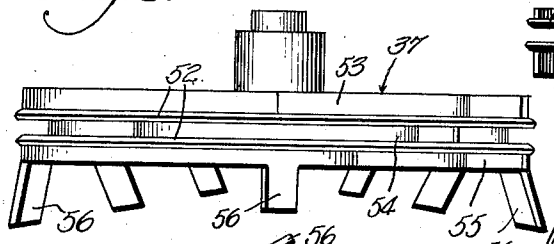
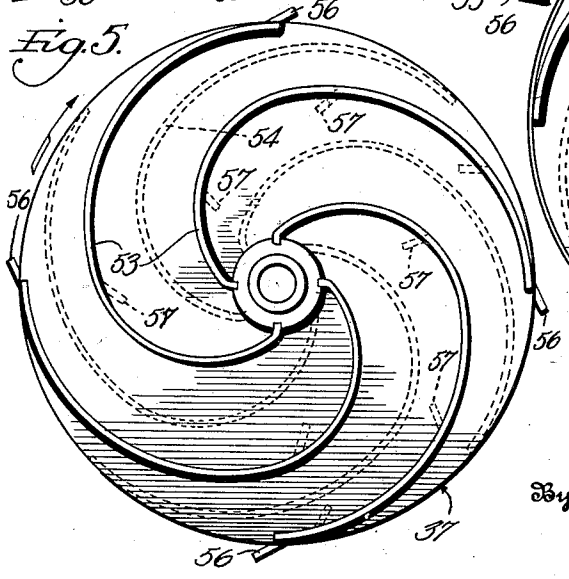


Fig. 5.



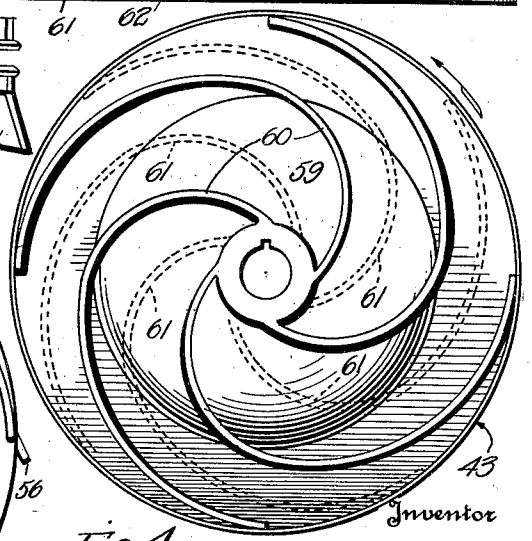


Fig. 4.

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1,960,726

APPARATUS FOR SEPARATING METALS FROM ORES

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Continuation of application Serial No. 420,568, January 13, 1930. This application April 10, 1931, Serial No. 529,230

10 Claims. (Cl. 209—465)

This invention relates to apparatus for separating metals, such as gold and the like from ores and more particularly it relates to the separation of fine particles of metal, such as flour gold, from waste material which is usually thrown away.

This application is a continuation of my application Serial No. 420,568, filed January 13th, 1930.

Heretofore, in the mining of metals, more particularly gold and the like, it has been impossible to efficiently separate the fine particles of metal such as flour gold and the like, from the ore. However, I have invented an apparatus which will economically and efficiently recover those fine particles of metal and will therefore prevent the huge loss previously incurred.

An object of the invention is to provide an apparatus of the character referred to wherein the ground ore containing the fine particles of metal and a liquid is fed into a tank, means being provided to separate the fine particles from the ore and to recover them in the tank.

Another object is to provide novel means for separating the material whereby the fine particles of metal will be positively urged to the bottom of the tank where they may be collected.

A further object is to provide a plurality of concentric impellers in the tank preferably rotatable in different directions, each impeller being provided with a plurality of spaced plates and a plurality of sets of arcuate conveying blades, the lowermost plate of each impeller being provided with a substantially central opening to permit the passage of material between the plates and through each impeller.

A further object is to provide a plurality of conveying and directing fingers on the lowermost plate of the lowermost impeller to insure a positive movement of the material in the bottom of the tank from the periphery toward the center thereof.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings I have shown a preferred embodiment of the apparatus. In this showing,

Figure 1 is a central vertical sectional view through the apparatus,

Figure 2 is a plan view,

Figure 3 is a front elevation of the upper impeller,

Figure 4 is a plan view of the upper impeller,

Figure 5 is a plan view of the lower impeller, and

Figure 6 is a front elevation of the lower impeller.

Referring to the drawings the numeral 10 designates a preferably cylindrical tank provided with an open top and closed at the bottom as indicated at 11. A plurality of legs 11′ are secured to the bottom to support the tank. A feed inlet 12 communicates with the bottom of the tank and a plurality of outlets 13, 14 and 15 respectively, which may be equipped with suitable valves (not shown), communicate with the tank at points substantially diametrically opposite the inlet 12. An annular flange 16 is secured to the outer periphery of the tank adjacent the top thereof.

The tank is adapted to receive quantities of crushed ore containing fine particles of metal and a liquid, and novel means are provided for separating the constituents of the material whereby the metal may be easily recovered. As shown, a support 17 is rigidly secured to the flange 16 by bolts or the like 18 and this support comprises a pair of downwardly diverging legs 19 and an integral horizontal portion 20 connecting the legs 19. One support 17 is arranged on each side of the tank at diametrically opposite points and a pair of transverse channel members 21 extend across the top of the tank, being secured to the horizontal portions 20 of the supports by means of bolts or the like 22. A second pair of supports 23 having diverging legs 24 and horizontal portions 25 are arranged to bridge across the channel members 21 and are secured to the latter by bolts or the like 26. A relatively wide channel member 27 is connected between the horizontal portions 25 of the supports 23 by means of bolts or the like 28 and the member 27 is provided with a substantially central opening in which a bearing 28′ for a rotatable shaft 29 is arranged.

As shown in Figure 1 the shaft 29 extends downwardly into the tank 10 and a ball bearing 30 is arranged above the bearing 28′ surrounding the shaft. A nut 31 or other similar means may be threaded on the upper end of the shaft to prevent vertical movement thereof. The lower end of the shaft 29 is provided with an opening adapted to receive the shank portion 32 of a stub shaft 33 and the latter is secured to the tank by means of a nut 34. A washer 35 may be interposed between the nut 34 and the bottom of the tank, and a bearing 36 surrounding the stub shaft 33 may be arranged between the lower end of the shaft 29 and the bottom of the tank. It will be obvious that the bottom of the shaft may be journalled directly in the bottom of the tank and it is immaterial how the shaft 29 is journalled so long as it is capable of rotating without undue friction. However, the arrange-

ment shown has proved efficient and is preferred.

An impeller indicated as a whole by the numeral 37, and which will be termed the lower impeller, has its hub portion keyed or otherwise suitably secured adjacent the lower extremity of the shaft 29 and a bearing 38 surrounds the shaft 29 above the hub portion of the lower impeller. The bearing 38 may be a floating bearing or it may be secured to a part of the device to be subsequently described. Adjacent the upper extremity of the shaft 29 a bevel gear 39 is keyed or otherwise suitably secured thereto and a bearing 40 surrounds the shaft below the gear 39. A tubular shaft 41 is arranged concentric with and outwardly of the shaft 29 and the upper end of the tubular shaft engages the lower portion 40' of the bearing 40, while the lower end engages a shoulder 42 arranged on the hub of the impeller 37. Adjacent the bottom of the shaft 41 the hub of an impeller indicated as a whole by the numeral 43, to be designated the upper impeller, is keyed or otherwise suitably secured thereto. If desired the bearing 38 previously referred to may be carried by the shaft 41. Adjacent the upper end of the shaft 41 a bevel gear 44 is keyed or otherwise suitably secured thereto and the lower surface of the gear 44 rests upon a ball bearing 45 supported on a bearing 46 suitably carried by the channel members 21.

The teeth of the bevel gears 39 and 44 are arranged to substantially face each other whereby they may mesh with a pinion 48 carried on a drive shaft 49 journalled in suitable bearings 50 secured to the channel members 21. Pulleys 51 are secured to the outer end of the drive shaft 49 and any suitable source of power may be utilized to drive the shaft 49. It will be obvious that the rotation of the bevel gears 39 and 44 with respect to the pinion 48 will cause the gears and consequently the shafts 29 and 41, and the impellers 37 and 43 to be rotated in opposite directions.

Referring to Figures 1, 5 and 6, the lower impeller 37 comprises a pair of spaced plates 52 which are turned downwardly at their outer peripheries. The upper surface of the upper plate 52 is provided with a plurality of rib-like blades 53 which are arranged arcuately from the hub portion of the impeller to points adjacent the periphery of the upper plate to provide a plurality of arcuate passages between the blades, whereby rotation of the impeller 37 will tend to draw objects from the periphery of the upper blade 52 to the center thereof. The plates 52 are spaced apart by a second set of blades 54 similar to the blades 53 except that the second set of blades are not arranged in the same vertical plane as the first set of blades, but are arranged substantially in stepped relation thereto. A third set of blades 55 are arranged on the lower surface of the lower plate 52 and these blades correspond to and are arranged in the same vertical planes with the blades 53. A plurality of conveying fingers 56 are arranged adjacent the outer extremities of the blades 55, and a plurality of directing fingers 57 are carried in spaced positions by the blades 55 inwardly of the conveying fingers for purposes to be described. As shown in Figure 1, the lower plate 52 is provided with a central opening 58' to permit the upward passage of material through the plate for a purpose to be described.

Referring to Figures 1, 3 and 4 the upper impeller 43 comprises a pair of spaced plates 58 similar to the plates 52 except that the outer peripheries thereof are turned upwardly. A cone shaped member 59 has its lower end formed integral with the upper surface of the upper plate 58 and the surface of the cone extends upwardly a substantial distance as indicated, the upper end of the cone being secured to the hub of the impeller. A plurality of blades 60 are arranged on the upper surface of the upper plate 58 and these blades are similar to the blades 53 except that they extend along the cone surface as well as along the upper surface of the plate, and are oppositely curved to the blades 53. A second set of blades 61 space the plates 58 apart and these plates correspond to the blades 54 of the lower impeller, but are also oppositely curved with respect thereto. A third set of blades 62 is arranged on the lower surface of the lower plate 58 corresponding to the blades 55 of the lower impeller but oppositely curved with respect thereto, and no fingers are carried by the blades 62. As will be shown, it is within the scope of this invention that the shapes and spacing of said plates and blades forming the impellers may be governed by their respective angular velocity as well as by the characteristics of the ore used.

A central opening 63 is also provided in the lower plate 58 to permit the upward passage of material through this plate. The impellers are arranged in the tank 10 as shown in Figure 1 and an annular partially cone shaped removable baffle 64 provided with a central opening 65 is arranged adjacent the upper impeller. A gasket 66 having a portion 67 spaced from the wall of the tank is arranged whereby a flange 68 on the baffle may be secured or fitted between the wall of the tank and the gasket. The baffle is provided with a conical shaped apron 69, designed so the lower end will have the necessary minimum clearance to permit rotation of blades 60. The construction and arrangement of the baffle is to retard the direct passage of material upwardly through the opening 65. A pair of handles 70 may be arranged on opposite sides of the baffle to permit the ready removal of the same.

Means are provided for preventing accidental displacement of the baffle while the apparatus is in operation. A pair of brackets 71 are secured to the walls of the tank on opposite sides thereof and are provided with horizontal portions 71' through which elongated T-headed bolts 72 are adapted to be threaded. The lower extremities of the bolts 72 extend into the upper surface of the baffle and it will be obvious that the latter may be rigidly secured in position.

In the practice of my invention the operation of the apparatus is as follows:

Power may be applied to the drive shaft 49 whereby the shafts 29 and 41 will rotate at a desirable speed usually from 150 to 175 R. P. M. and the impellers 37 and 43 will be rotated in opposite directions. The ore is first ground to a suitable fineness, the degree of which will depend on the character and nature of the ore. The ground ore and a liquid, preferably water, are fed into the tank 10 through the inlet 12 and it is desired that the feeding be regulated to a speed sufficient to maintain the level of the mixture at a height which will produce best results which is preferably substantially at the height of the water level shown in Figure 1 while the apparatus is in operation.

As indicated by the arrow in Figure 5, the lower impeller 37 is to be rotated in a clockwise direc-

tion, while the upper impeller 43 is to be rotated in a counter-clockwise direction as indicated by the arrow in Figure 4.

The mixture enters the tank at the lower extremity of the inlet 12 and is worked to the center of the tank by means of the rotating blades 55, the conveying fingers 56 and the directing fingers 57. The arcuate shape of the blades 55 causes the mixture to move from the inlet 12 toward the opening 58' and the fingers 56 and 57 assist in conveying and directing the mixture into the passages formed by the blades 55, thereby preventing clogging at the lower end of the inlet 12. It will be obvious that as the mixture enters the tank, a part of the liquid and soluble matter therein will be by-passed upwardly between the wall of the tank and the outer periphery of the lower impeller.

As the continuous incoming mixture is worked toward the center of the bottom of the tank, it tends to build up in the center and work its way through opening 58'. However, it will be noted that the blades 54 between the plates 52 are also arcuate shaped and will also draw material from the periphery of the lower impeller toward the center and thus a force will be exerted against the mixture working its way through opening 58'. If the force exerted to carry the mixture upwardly through opening 58' is just equal to the force exerted by the action of the blades 54, then it would be obvious that the material would clog the apparatus at that opening and the device would not operate properly. Therefore, it is necessary to have slightly more force exerted to carry the mixture upwardly through opening 58' than is exerted by the action of the blades 54, and this slight additional force is obtained, in the present case, because the hydraulic head in the feed inlet 12 is continuously feeding new material into the bottom of the tank.

Actually, the slight difference in pressure causing the mixture to move upwardly through opening 58' moves the mixture at such a slow rate of speed that the constituents of the mixture having the greatest specific gravity have ample time to effectively and positively sink to the bottom of the tank. It is during this slow movement of the mixture that the fine particles of metal, because of their specific gravity, sink to the bottom of the tank where they may be recovered. Therefore, it will be seen that it is essential in my process to prevent agitation and too rapid movement of the mixture, as the fine particles of metal then would not be able to sink to the bottom of the tank, but would be carried away. Likewise, the mixture cannot be permitted to come to a state of complete rest adjacent the opening 58' or the apparatus would clog, as previously stated. Therefore, it becomes necessary to slowly move the mixture without excessive gushing and pulsating of the contents in the tank, whereby the fine particles of metal will have ample time to sink to the bottom of the tank.

The slow moving mixture, minus the constituents of sufficient weight to sink to the bottom of the tank, gradually works its way through opening 58', and through the passages formed by the blades 54, against the centripetal pressure present therein, until it reaches the outer periphery of the lower impeller. These lighter constituents of the mixture are assisted somewhat in reaching the outer periphery of the lower impeller by means of a slight suction created by the rotation of upper blades 53 on the lower impeller and lower blades 62 on the upper impeller.

The outer edges of plates 52 are turned slightly downwardly to direct toward the bottom of the tank for reprocessing, any chance heavy particles emerging at the periphery of the lower impeller.

The lighter constituents emerging from between the plates 52 are picked up by the upstream in the annular space between the lower impeller and the tank, caused by the suction of upper blades 53 of the lower impeller and lower blades 62 of the upper impeller and are directed toward opening 63 in the upper impeller which is rotating in a counter-clockwise direction. The force exerted by the action of the arcuate blades 61 between plates 58 tends to restrict the passage of the lighter constituents through opening 63, but again the difference in pressure exerted to move the lighter constituents through opening 63 and the pressure exerted by blades 61 is sufficient to permit these lighter constituents to move slowly through the passages formed by the blades 61 toward the periphery of the upper impeller.

The action of the blades 61 in retarding the flow through the opening 63 is intended to and does prevent excessive gushing and pulsating of the contents of the tank and therefore, the upper impeller, in a broad sense, is functioning as a governor to insure the proper slow speed of the mixture through the apparatus.

It will be noted that the outer edges of the plates 58 are turned slightly upwardly and these edges will direct the material emerging from between the plates 58 upwardly into the annular space between the upper impeller and the tank wall. The upper blades 60 then carry the material, first horizontally and then diagonally upwardly through the opening 65, and the lighter constituents with the liquid then pass out of the tank through the outlet 13.

The ring or gasket 66, together with the baffle 64 and its conical apron 69, serve to prevent a direct upward flow, and compel the material to be discharged through outlet 13 to pass out of opening 65. The conical apron 69 is designed whereby the lower edge is sufficiently clear of blades 60 to permit free rotation of the latter, and this clearance preferably increases slightly toward the outlet 65.

After a desired amount of ore has been run through the apparatus, the fine particles of metal and other heavy matter may be removed from the tank. It has been found in practice that the particles of metal constitute the bulk of the material recovered from the bottom of the tank and consequently, it will be obvious that the fine particles of metal may be readily collected.

When it is desired to clean out the apparatus, the baffle 64 may be easily removed by removing the T-bolts 72, and the impellers may also be lifted out of the tank by removing the necessary bolts.

It is believed apparent that I have provided an apparatus and a process in which the fine particles of precious metals may be quickly and efficiently separated from their ores without loss and collected in substantially a pure state.

It is to be understood that the form of the invention herewith shown and described is to be taken as the preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. Apparatus of the character described comprising a container, means for feeding a mixture of metal bearing material and a liquid into said

container, a rotatable impeller arranged in said container and divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section, said mixture being movable toward said opening at a rate of speed slow enough to enable the metal to separate itself from said mixture and sink to the bottom of the container before the metal passes through said opening, the residue of said mixture being movable through said opening and out of said container.

2. Apparatus constructed in accordance with claim 1 wherein a plurality of depending directing and conveying fingers are carried by the lowermost section of said impeller.

3. Apparatus of the character described comprising a container, means for feeding a mixture of metal bearing material and a liquid into said container, a rotatable impeller arranged in said container and divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section, said mixture being movable toward said opening at a rate of speed slow enough to enable the metal to separate itself from said mixture and sink to the bottom of the container before the metal passes through said opening, a second impeller arranged above and rotatable in a direction opposite to the direction of rotation of said first named impeller, said second impeller being divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost horizontal section being provided with a substantially central opening communicating with the next adjacent section of said second impeller, said residue being movable substantially upwardly from said first impeller toward said opening in said second impeller at a rate of speed slow enough to prevent gushing and excessive pulsating of the contents of the container, and being movable out of said container.

4. Apparatus constructed in accordance with claim 3 wherein a plurality of depending directing and conveying fingers are carried by the lowermost section of said first impeller.

5. Apparatus of the character described comprising a container, a rotatable impeller arranged in said container and divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section, means for feeding a mixture of a metal bearing material and a liquid into the container, means for rotating said impeller whereby said mixture will be moved toward said opening and such movement will be almost totally opposed by the action of the said section of the impeller with which said opening communicates whereby the movement of said mixture toward said opening will be slow enough to enable the metal to separate from the mixture and sink to the bottom of the container by reason of its weight, and means for moving the residue of the mixture out of the container.

6. Apparatus constructed in accordance with claim 5 wherein a plurality of depending directing and conveying fingers are carried by the lowermost section of said impeller.

7. Apparatus of the character described comprising a container, a rotatable impeller arranged in said container and divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section, a second impeller arranged above and rotatable in a direction opposite to the direction of rotation of said first named impeller, said second impeller being divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section of said second impeller, means for feeding a mixture of a metal bearing material and a liquid into the container, means for rotating said first impeller whereby said mixture will be moved toward said opening therein and such movement will be almost totally opposed by the action of the said section of said first impeller with which said last mentioned opening communicates whereby the movement of said mixture toward said last mentioned opening will be slow enough to enable the metal to separate from the mixture and sink to the bottom of the container because of its weight, means for rotating said second impeller whereby the residue of said mixture will be moved toward the said opening in said second impeller and such movement will be almost totally opposed by the action of the said section of said second impeller with which said last mentioned opening communicates whereby the movement of said residue will be slow enough to prevent gushing and excessive pulsating of the contents of said container, and means for moving said residue out of the container.

8. Apparatus constructed in accordance with claim 7 wherein a plurality of depending directing and conveying fingers are carried by the lowermost section of said first impeller.

9. Apparatus constructed in accordance with claim 7 wherein a plurality of depending directing and conveying fingers are carried by the lowermost section of said first impeller, a baffle arranged above said second impeller and provided with a substantially central opening, the uppermost section of said second impeller being substantially cone shaped to direct the residue of said mixture through said last named opening.

10. Apparatus of the character described comprising a container, a rotatable impeller arranged in said container and divided into a plurality of substantially horizontal sections, each section being provided with a plurality of arcuate passageways, the lowermost section being provided with a substantially central opening communicating with the next adjacent section, means for feeding a mixture of a metal bearing material and a liquid into the container, means for rotating said impeller whereby said mixture will be moved toward said opening and such movement will be almost totally opposed by the action of the said section of the impeller with which said opening communicates whereby the movement of said mixture toward said opening will be slow enough to enable the metal to separate from the mixture and sink to the bottom of the container by reason of its weight, means for preventing gushing and excessive pulsating of the residue of said mixture, and means for moving said residue out of the container.

WALTER D. BRISCOE.