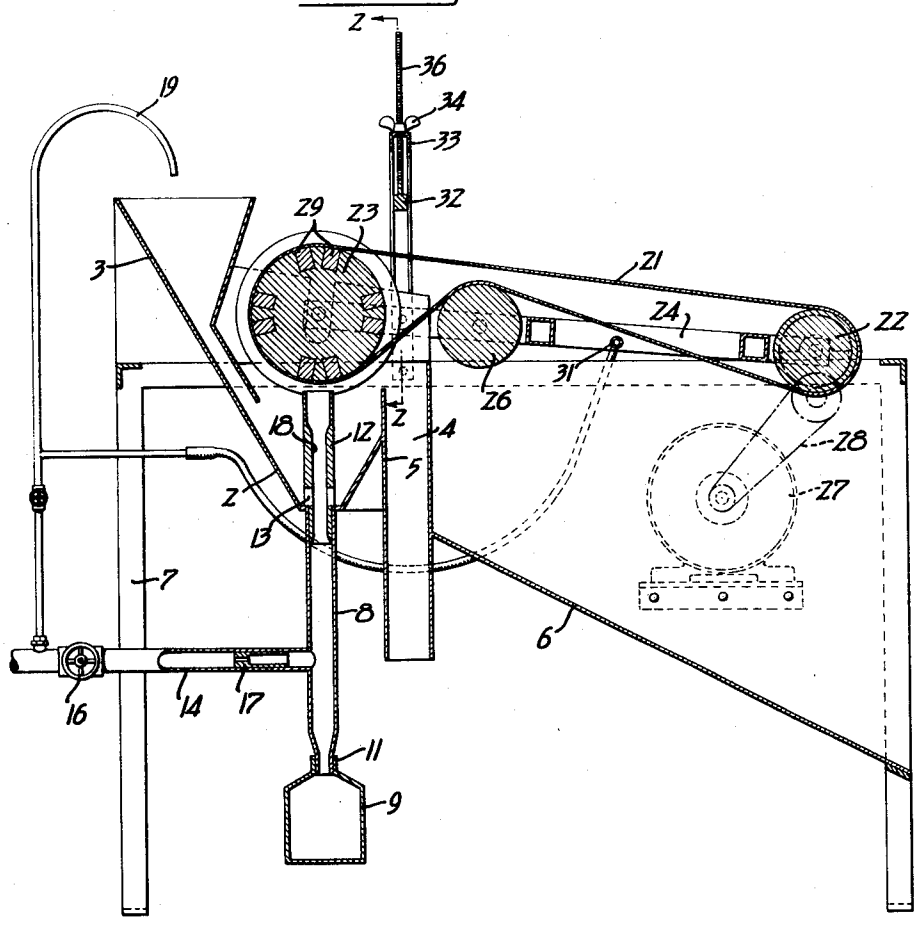
Feb. 2, 1943. M. S. ROBERTSON 2,309,923

APPARATUS FOR SEPARATING FINELY DIVIDED MATERIALS

Filed July 29, 1940

Fig. 1



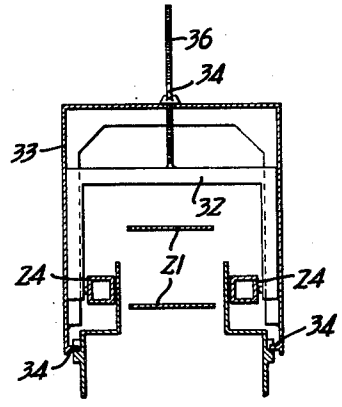


Fig. 2

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APPARATUS FOR SEPARATING FINELY DIVIDED MATERIALS

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4 Claims. (Cl. 209—39)

My invention relates to apparatus for separating particles of material; and more particularly to a device for separating material containing magnetic particles.

It is among the objects of my invention to provide apparatus for effectively separating small particles of finely divided material.

Another object is to provide apparatus of the character described having magnetic means associated with a counterflow of fluid for separating particles of material.

A further object is to provide improved means for recovering fine gold from sand.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing:

Figure 1 is a vertical sectional view of recovery apparatus embodying the improvements of my invention; and

Figure 2 is a fragmentary transverse sectional view taken in a plane indicated by line 2—2 of Figure 1.

Particles of valuable substances are often associated with other finely divided particles containing magnetic materials. Thus many black sands, such as found on ocean beaches, contain fine gold in quantities justifying its recovery if suitable equipment is available for effecting its separation from the lighter sand and magnetic particles. Other valuable substances such as chromium and titanium are likewise often found mixed with finely divided foreign materials. Various devices embodying magnetic means have been used to get rid of the magnetic particles, but such devices have not been satisfactory for the separation of finely divided materials. My improved apparatus overcomes the difficulties experienced in recovering small particles of gold and the like.

In terms of broad inclusion, my apparatus for recovering dense particles from material comprises fluid counterflow means for separating dense from lighter particles; means associated with the counterflow for removing magnetic particles from the fluid; and fluid discharge means to carry off the lighter particles.

In greater detail, and referring to the drawing, my apparatus comprises a tank or chamber 2 for receiving material, such as gold-bearing sand, from a suitable hopper 3. A discharge passage 4 is provided for lighter material overflowing a side wall 5 of the chamber, and a chute 6 is provided for the magnetic material; these structural parts all being supported by a suitable frame 7. The apparatus illustrated is adapted for operation by a single person who feeds the sand by hand into the hopper. Of course it is understood that the unit may be made larger and adapted for use with power equipment for feeding sand to the apparatus.

Fluid counterflow means are provided for dispersing particles of the material introduced into chamber 2 and for separating dense from lighter particles of the material. For this purpose an upright tube 8 is arranged to extend downwardly from the bottom of the chamber, through which the dense particles of gold may fall into a receiver 9 at the lower end of the tube. The reduced end of the tube seats in a neck 11 to provide a tight joint, yet permit removal of the receiver for taking out the collected values. An upper extension 12 of the tube projects into chamber 2 and is provided with side openings 13 adjacent the bottom of the chamber for receiving material from the latter.

Water is introduced into the side of tube 8 below chamber 2 through a supply duct 14. The flow of water is regulated by a suitable valve 16, and a uniform flow of fluid into the tube is insured by an orificed insert 17 disposed in duct 14. The closure provided at the lower end of tube 8 by receiver 9 causes the water to flow upwardly through the tube. If desired, a Venturi passage 18 may be formed in the tube adjacent inlet openings 13. Such a passage helps to draw the material into the moving column of water.

As sand feeds into chamber 2 from hopper 3, assisted by a small stream of water from pipe 19, the material is directed toward tube openings 13 by the sloping walls of chamber 2. The particles entering openings 13 tend to fall in the tube under the influence of gravity, but are opposed by the counterflow of fluid. The denser gold particles fall against the counterflow and are finally deposited in receiver 9, while the lighter sand particles are carried up over the top of the tube and are discharged with the fluid overflowing chamber wall 5. Any gold particles which happen to be carried over the top of the tube settle out in the pool of water in chamber 2 and are redrawn into the tube through openings 13 and again subjected to the

counterflow action, until finally all of the values are recovered in receiver 9.

Means are provided for removing the magnetic particles from the fluid emerging from the counterflow tube. As shown in Figure 1, a conveyor belt 21 is arranged to run on pulleys 22 and 23 journaled on a frame 24 pivoted about the axis of pulley 22. An idler roll 26 also journaled on frame 24 keeps the belt in contact with the lower portions of pulley 23. The conveyor belt is driven by a suitable motor 27 connected with pulley 22 through a suitable drive 28. In a small portable apparatus this motor may be operated from a storage battery.

Pulley 23 of the conveyor is disposed above the counterflow tube so that the particles emerging from the latter are directed against belt 21. A series of permanent magnets 29 are mounted about the periphery of pulley 23 so that the magnetic particles are caused to adhere to the belt and be carried upwardly over the top of the pulley. When on the upper reach of the belt the particles are carried along by the conveyor and finally discharged over pulley 22 onto chute 6. An upwardly directed spray of water from a perforated tube 31 washes off any particles clinging to the under reach of the belt.

Means are also provided for adjusting conveyor pulley 23 relative to the upper end of the counterflow tube. As best shown in Figure 2, a yoke 32 is pivoted to frame 24 and is slidably mounted in a guide 33 having pins 34 seated in sockets on the main frame. Adjustment is effected by a wing nut 34 bearing against a cross arm of guide 33 and threaded on a screw 36 projecting upwardly from yoke 32. Turning of this nut thus moves conveyor frame 24 about its pivot axis to raise and lower pulley 23 relative to the counterflow tube.

An important feature of the apparatus thus described is that magnetic particles only are carried off on belt 21. The general experience with magnetic separating devices is that particles of gold or other values are trapped between bunched magnetic particles and carried off with the latter. This is particularly true if the values are finely divided, as is free gold in black sand. Such difficulty is avoided in my apparatus because the particles are freed from one another and widely dispersed throughout the fluid by the counterflow action. Any gold particles that pass over the top of the tube are therefore not caught between magnetic particles attracted to the belt, but settle out in chamber 2 and are resubmitted to the counterflow action until finally recovered in receiver 9.

If the material being worked contains other non-magnetic values, such as chromium or titanium, these lighter particles are carried off with the overflow and are collected with the sand discharged from passage 4. Because of the division between the particles maintained by the counterflow, the lighter values are also prevented from being trapped by the magnetic particles and are free to travel off with the overflow. An efficient apparatus is thus provided for effecting separation between magnetic and non-magnetic particles.

I claim:

1. Recovery apparatus comprising a chamber into which particles of material may be fed and having an overflow lip, an upright tube extending through the bottom of the chamber to a level adjacent but below that of the lip and having an aperture in the wall thereof adjacent the bottom of the chamber through which particles of material may pass into the tube, means for establishing a flow of fluid upwardly through the tube to carry the lighter particles upwardly to overflow the top thereof into the chamber, and means for removing magnetic particles from the fluid emerging from the top of the tube.

2. Recovery apparatus comprising a chamber into which particles of material may be fed and having an overflow lip, an upright tube having a Venturi section therein and extending through the bottom of the chamber to a level adjacent but below that of the lip and having an aperture in the Venturi section wall adjacent the bottom of the chamber through which particles of material may pass into the tube, means for establishing a flow of fluid upwardly through the tube to carry the lighter particles upwardly to overflow the top thereof into the chamber, and means for removing magnetic particles from the fluid emerging from the top of the tube.

3. Recovery apparatus comprising a conical chamber into which particles of material may be fed, an upright tube extending through the bottom of the chamber to adjacent the top thereof and having an aperture in the wall adjacent the bottom of the chamber through which particles of material may pass into the tube, means for establishing a flow of fluid upwardly through the tube so that heavy particles may fall therethrough and lighter particles be carried upwardly to overflow the top of the tube into the chamber and magnetic means adjacent the top of the tube for removing magnetic particles from the overflowing fluid.

4. Recovery apparatus comprising a frame, an upright tube arranged in the frame, a conical basin for receiving particles of material and surrounding the upper portion of the tube, said tube having an aperture in the wall thereof at the bottom of the basin through which particles of material may pass into the tube, means for establishing a flow of fluid upwardly through the tube to carry lighter particles upwardly to the top thereof, means at the bottom of the tube for receiving heavier particles falling therethrough, a magnetic pulley disposed closely above the top of the tube, a drive pulley on the frame, a belt around the magnetic and drive pulleys, power means for turning the drive pulley to move the lower reach of the belt into the fluid at the top of the tube so that magnetic particles are picked up from the fluid and carried out over the upper reach of the belt, and means for washing the magnetic particles off of the belt.

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