Aug. 12, 1924. 1,504,280

A. H. STEBBINS

CONCENTRATOR

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Fig. 1

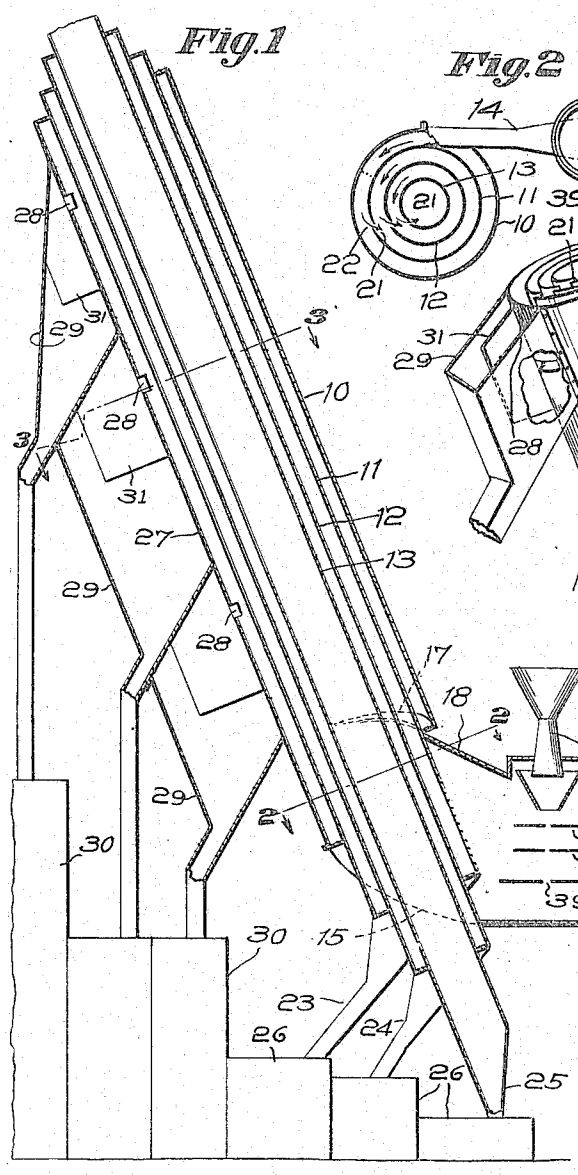
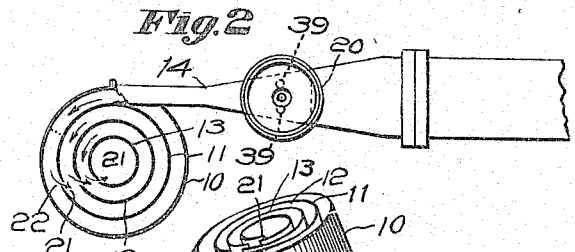


Fig. 2



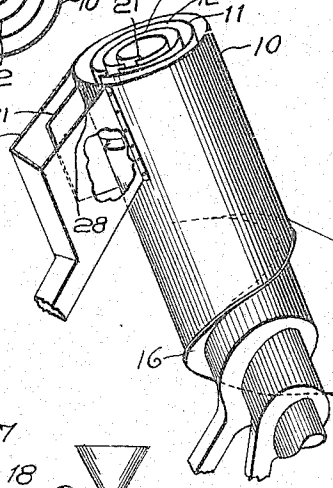
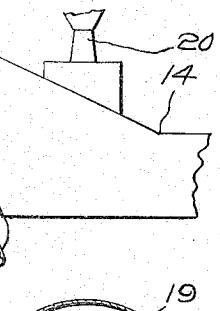


Fig. 4



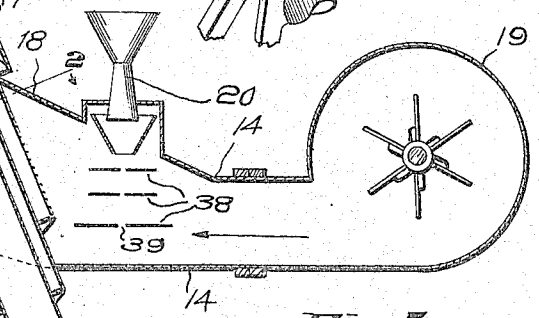


Fig. 5

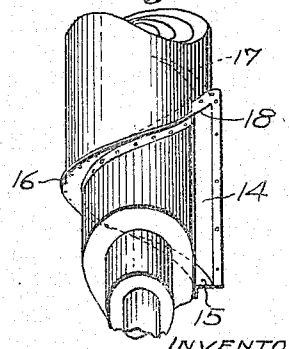
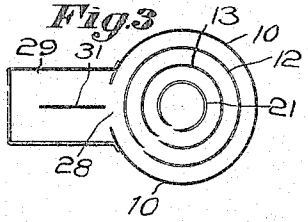


Fig. 3



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Fig. 6

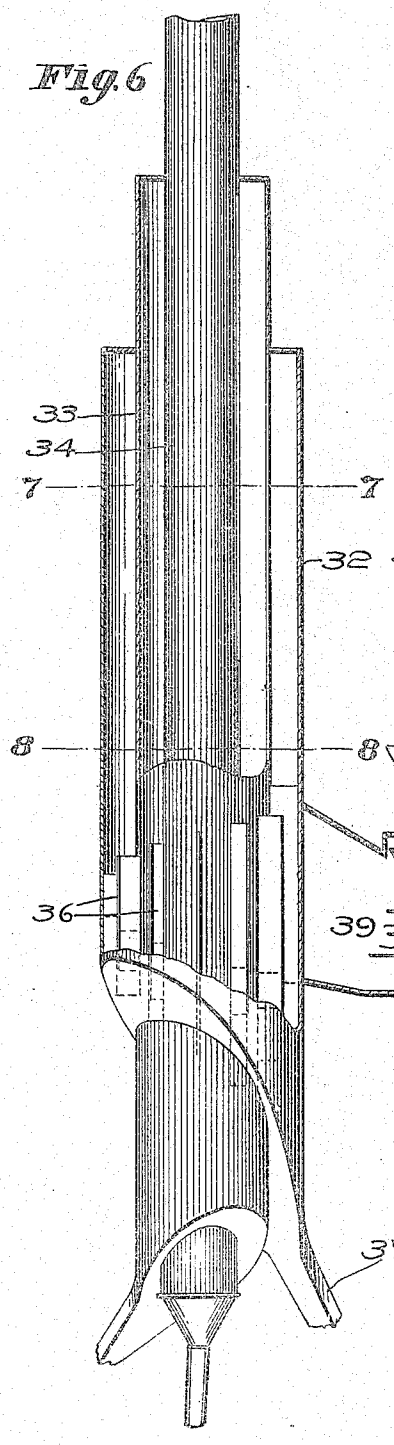


Fig. 7

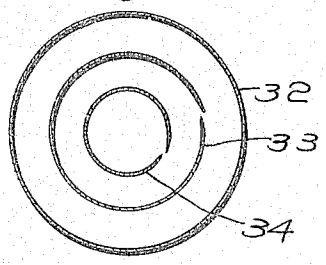
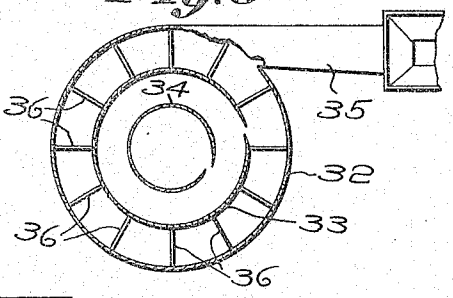


Fig. 8



Inventor:
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by Robt. P. Harris,
Attorney

Patented Aug. 12, 1924. 1,504,280

UNITED STATES PATENT OFFICE.

ALBERT H. STEBBINS, OF LOS ANGELES, CALIFORNIA.

CONCENTRATOR.

Application filed April 12, 1922. Serial No. 551,933.

To all whom it may concern:

Be it known that I, ALBERT H. STEBBINS, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented an Improvement in Concentrators, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to concentrators of the type in which the materials to be treated are caused to whirl about the interior of a container.

Concentrators are adapted to separate materials by reason of their difference in specific gravity, shape or frictional properties, or by a combination of two or more of these properties, and are extensively used in the treatment of ores to separate the values from the usual impurities.

Most ores have their values distributed throughout a relatively large amount of impurities or foreign matter, and as a result the values obtained usually constitute a small portion of the mass of materials treated. It is therefore important to reduce as far as practical the labor involved in treating this mass of materials, and at the same time to remove the values as completely as possible.

In ore treating mills it is usually desirable to concentrate the materials at various stages of the ore treatment, and the materials commonly are subjected to the first concentration operation while the particles are relatively large in size so that some of the values or concentrates may be removed at this stage, and other values or concentrates are removed at succeeding stages as the materials are reduced in size. In most cases the values have a higher specific gravity than the accompanying impurities and advantage is taken of this difference in specific gravity in performing the concentrating operations.

The present invention is designed more particularly for the treatment of ores or other materials that have been reduced to a fine size, and one important feature of the present invention consists in a container having one or more tubes disposed therein in spaced relation to the walls of the container and about which air bearing the materials to be treated is caused to whirl so that the heavier materials will be thrown outwardly by centrifugal force.

Another important feature of the present invention consists in means for directing air bearing the materials to be treated upwardly into a container with a whirling movement so that particles of different specific gravity will be carried upwardly to different heights, and in means for tolling off at different points along the container the particles carried upwardly by the air.

Still another feature of the invention consists in a container having a plurality of concentric tubes therein arranged one within the other so that air introduced into the container and bearing the materials to be treated will pass inwardly from one tube to the other and will give up part of the materials in each tube.

Other features of the invention and novel combination of parts in addition to the above will be hereinafter described in connection with the accompanying drawings which illustrate one good practical form thereof.

In the drawings:

Fig. 1 is a vertical sectional view through a concentrator constructed in accordance with the present inventoin.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a perspective view of the lower portion of the concentrator of Fig. 1.

Fig. 5 is a side view of the lower portion of the concentrator of Fig. 1 and showing the air delivering conduit in section.

Fig. 6 is a vertical sectional view through a modified type of concentrator.

Fig. 7 is an enlarged sectional view on the line 7—7 of Fig. 6, and:—

Fig. 8 is an enlarged sectional view on the line 8—8 of Fig. 6.

In the present invention, concentration of the materials is effected by directing air carrying the materials to be treated into a container to whirl thereabout so that the heavier particles are thrown outwardly by centrifugal force while the air and lighter particles escape from the container by passing inwardly through one or more tubes arranged centrally within the container. In the embodiment of the invention shown in Figs. 1 to 5 inclusive a container 10 is provided having three tubes 11, 12 and 13 therein arranged one inside the other to form annular chambers therebetween. The number of tubes provided, however, may be increased or decreased as desired, and each tube pref-

erably has an opening in its wall to admit air from the annular chamber that surrounds it.

In the embodiment of the invention illustrated air is introduced into the lower portion of the container 10 through a conduit 14 disposed substantially tangentially to a wall of the container as shown in Figs. 2 and 5, and having an elongated construction in cross section as shown in Fig. 5 to direct the air into the container so that it will whirl therein. The lower wall of the conduit 14 preferably curves upwardly as at 15, and curves about the tube 11 in the form of a spiral 16 to direct the air upwardly with a spirally whirling movement. This spirally curved wall 16 may serve to close the lower end of the container 10 and may terminate at a point 17 preferably above the upper wall 18 of the conduit 14. Various means may be provided for causing air to enter the container 10 through the conduit 14, and in the instance shown air is forced in by a fan 19. The materials to be treated may be introduced into the path of the air either before or after it enters the container 10, and in the construction shown a hopper 20 is provided upon the conduit 14 for delivering the materials into the conduit.

As stated, it is desirable to conduct the air that enters the chamber 10 inwardly to pass successively through the tubes 11, 12 and 13, and to this end, each tube is provided with a slot 21 that extends throughout a substantial portion of the length of the tube, and adjacent each slot is provided a lip 22 that serves to direct the air whirling adjacent a tube inwardly through its slot. The upwardly whirling air carries the materials upwardly into the container 10 and causes the heavier particles to be thrown outwardly by centrifugal force against the walls of the container, whereupon it will slide down these walls. The air from which the heavier particles have been removed will enter the tube 11 through the slot 21 and while whirling therein will release additional particles and then pass into the next inner tube. Some materials will be released by the air in each tube and will slide downwardly therein. The air that reaches the innermost tube 13 may be conducted from either end thereof, and in the present construction may escape from the upper end of the tube 13.

It is desirable to provide means for removing from the lower ends of the tubes 11, 12 and 13 the materials collected therein, and to this end the tubes are provided with discharge spouts 23, 24 and 25 respectively, each of which leads into a receptacle 26 constructed to prevent air from escaping therefrom.

In many cases it may be desirable to separate the materials that are released by the air in the container 10 into two or more grades, it being understood that materials of different specific gravity will be carried upwardly to different heights within the container. This may be readily accomplished by supporting the container and tubes therein at an angle inclined somewhat to the vertical as shown in Fig. 1, so that the materials sliding downwardly within the container will travel along the lower inclined wall 27. The materials may then be tolled off from the container at different heights lengthwise thereof, and the materials removed at different heights will possess different specific gravity. In the construction shown the lower wall 27 of the container has openings 28 formed therein at spaced intervals through which the heavier materials sliding downwardly along the wall 27 may escape. Each opening 28 may discharge into a hopper 29 secured one above the other to the container 10, and these hoppers preferably discharge into the closed receptacles 30. A baffle plate 31 may extend across each opening 28 to check the whirling movement of the air that enters these openings. It will be understood that the upper end of the container 10 and tubes 11 and 12 are closed as shown.

In some cases it may not be desirable to support the concentrator at an inclination as shown in Fig. 1, or to remove the materials therefrom at different points along its length, and in this case the concentrator may be supported in a vertical position as shown in Fig. 6. The construction of this figure differs from the construction of Figs. 1 to 5 inclusive in that the materials that are released by the air in the outer container 32 are delivered from the container at its lower end. In this construction slotted tubes 33 and 34 are disposed within the container 32 as in Fig. 1 and air is led into the container through a conduit 35 disposed as in Fig. 1. In Fig. 6, however, the air from the conduit 35 is directed upwardly by a plurality of radially disposed blades 36 extending in an upright position between the container 32 and tube 33, and the upper ends of these blades terminate one slightly above the other in the path of a spiral as shown, to deflect the incoming air upwardly. As a result of this construction the materials released by the air in the container 32 may fall downwardly into the lower end of the container between the blades 36 and may be discharged through the spout 37.

It is desirable that the area of the annular spaces between the container and tubes shall be substantially the same, and this may be provided for by successively increasing the length of the inner tubes as shown in Fig. 1 but more pronounced in Fig. 6. From the present construction it will be apparent that

while it is necessary to reduce the diameter of the tubes as they are placed one inside of the other, a corresponding reduction in area may be avoided by increasing the length of the tubes.

It will be apparent that the air moves upwardly as it passes inwardly from one tube to the other, it is therefore desirable to progressively increase the length of the inner tubes at their upper ends, and to increase the length of the slots upwardly in a corresponding manner to accommodate the upward movement of the air. The air that enters the inner tube 34 may be discharged from the upper end thereof, or from a point near its lower end and while in most cases it may be desirable to provide means for blowing air in through the conduit 35, it may be desirable in some cases to draw air in through the conduit by connecting the inner tube 34 with suitable exhaust means.

The feed hopper 20 should be so constructed that it will prevent the air within the conduit 14 from escaping through the hopper, and this may be accomplished by providing the hopper with a restricted throat. as shown, which will normally be closed by the materials. If the materials continue to flow into the conduit 14 when the fan 19 is not operating these materials may completely close the air passage within the conduit. To prevent this apertured plates 38 may be provided within the conduit 14 one above the other upon which the materials are delivered by the hopper 20, and the materials pass downwardly thru the apertures 39 from one plate to the other. The relatively small piles of materials that form below the apertures 39 will not offer sufficient resistance to the passage of air thru the conduit to completely block the passage of air, and as air squeezes thru the space between the top of a pile and the adjacent plate 38 it will increase the size of the opening by carrying off the material.

What is claimed is:

1. A concentrator comprising, in combination, an upwardly extending container, a plurality of tubes arranged concentrically within the container and having openings in their walls for the passage of air inwardly from one tube to the other, the tubes having their length increased in the order in which they are arranged one within the other to increase the area of the tubes, means for introducing air bearing the materials to be treated into the container with a spirally whirling upward movement to throw the heavier particles outwardly by centrifugal force, means for discharging air from the innermost tube, and means for discharging from the container and tubes the materials deposited therein by the air passing through the concentrator.

2. A concentrator comprising, in combination, a tubular container extending upwardly in an inclined direction, a plurality of tubes mounted concentrically within the container to provide annular air chambers and each tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from one tube to the other, and a conduit for delivering air loaded with the materials to be treated tangentially into the lower portion of the container and having a floor portion that curves around the outer tube and is bent upwardly to direct the air upwardly with a spiral whirling movement within the container to throw the heavier particles outwardly by centrifugal force away from the tube slot while the air freed from the heavier particles passes inwardly from one tube to the other through the slots.

3. A concentrator comprising, in combination, an upwardly extending tubular container, a plurality of tubes mounted concentrically within the container to provide annular air chambers and each tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from one tube to the other, and a conduit for delivering air loaded with the materials to be treated into the lower portion of the container with an upward whirling movement, and a floor portion that curves upwardly around the outer tube to direct the air upwardly with a spiral whirling movement about the container to throw the heavier particles outwardly away from said slot while the air freed from the heavier particles passes inwardly from one tube to the other through the slots.

4. A concentrator comprising, in combination, an upwardly extending tubular container, a plurality of tubes mounted concentrically within the container to provide annular air chambers and each tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from one tube to the other, means for delivering air loaded with the materials to be treated into the lower portion of the container with an upward whirling movement that causes the air to whirl about the container to throw the heavier particles outwardly away from said slot while the air freed from the heavier particles passes inwardly from one tube to the other through the slots, and lips at the slots for directing the air whirling adjacent a tube inwardly through its slot.

5. A concentrator comprising, in combination, an upwardly extending tubular container, a plurality of tubes mounted concentrically within the container to provide annular air chambers and each tube having a slot extending throughout a substantial portion of its length for the passage of air

inwardly from one tube to the other, means for delivering air loaded with the materials to be treated into the lower portion of the container with an upward whirling movement that causes the air to whirl about the container to throw the heavier particles outwardly away from said slot while the air freed from the heavier particles passes inwardly from one tube to the other through the slots, and receptacles at the lower end of the container and tubes for receiving the materials that are released from the air through the combined action of gravity and centrifugal force.

6. A concentrator comprising, in combination, a tubular container extending upwardly in an inclined direction, a plurality of tubes mounted concentrically within the container to provide annular air chambers and each tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from one tube to the other, means for delivering air bearing the materials to be treated into the lower portion of the container and for directing the air upwardly with a spiral whirling movement within the container to throw the heavier particles outwardly by centrifugal force away from the tube slot while the air freed from the heavier particles passes inwardly from one tube to the other through the slots, and means at the under side of the inclined container for tolling off at different points lengthwise of the container the heavier particles carried upwardly by the air.

7. A concentrator comprising, in combination, an upstanding container, a tube within the container and forming an annular air passage within the container and the tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from the container, means for directing air bearing the materials to be treated substantially tangentially into the lower portion of the container and for directing it upwardly therein to cause the air to whirl about the tube as it rises within the annular chamber to cause the heavier particles to be thrown outwardly by centrifugal force away from said slot while the air from which the heavier materials are removed passes inwardly into the tube to whirl therein and release from the air additional particles, and means for receiving the materials that settle in the lower portion of the container and tube.

8. A concentrator comprising, in combination, an upstanding container, a tube extending through the container to form an annular chamber therein and projecting from the lower end of the container, said tube having a slot extending throughout a substantial portion of its length for the passage of air inwardly from the container, a conduit for directing air bearing the material to be treated tangentially into the lower portion of the container and having a floor portion that curves around the lower portion of the tube and is bent upwardly to direct the air upwardly within the annular chamber with a spiral whirling movement that throws the heavier particles outwardly by centrifugal force away from said slot while the air from which the heavier materials are removed passes inwardly into the tube to whirl therein for further treatment.

In testimony whereof, I have signed my name to this specification.

ALBERT H. STEBBINS.