

May 21, 1935.

E. A. COLBURN, JR

2,002,000

MIXING APPARATUS

Original Filed March 26, 1927 2 Sheets-Sheet 1

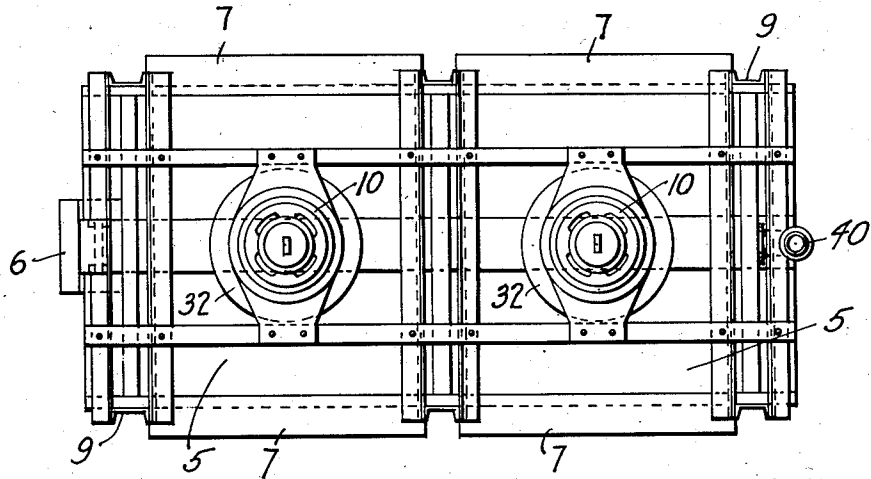
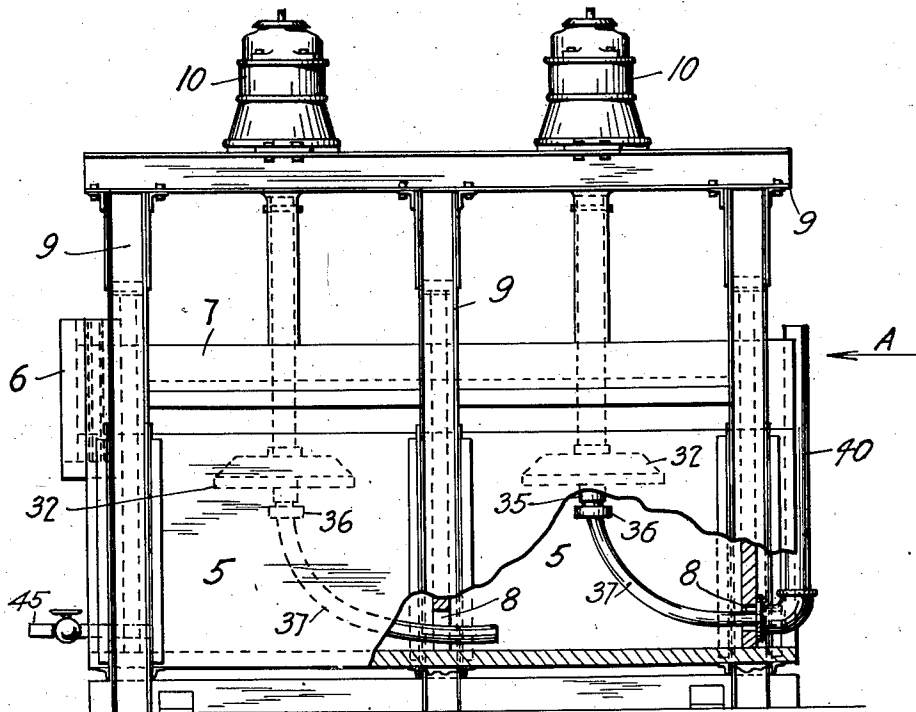


FIG. 2



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FIG. 1

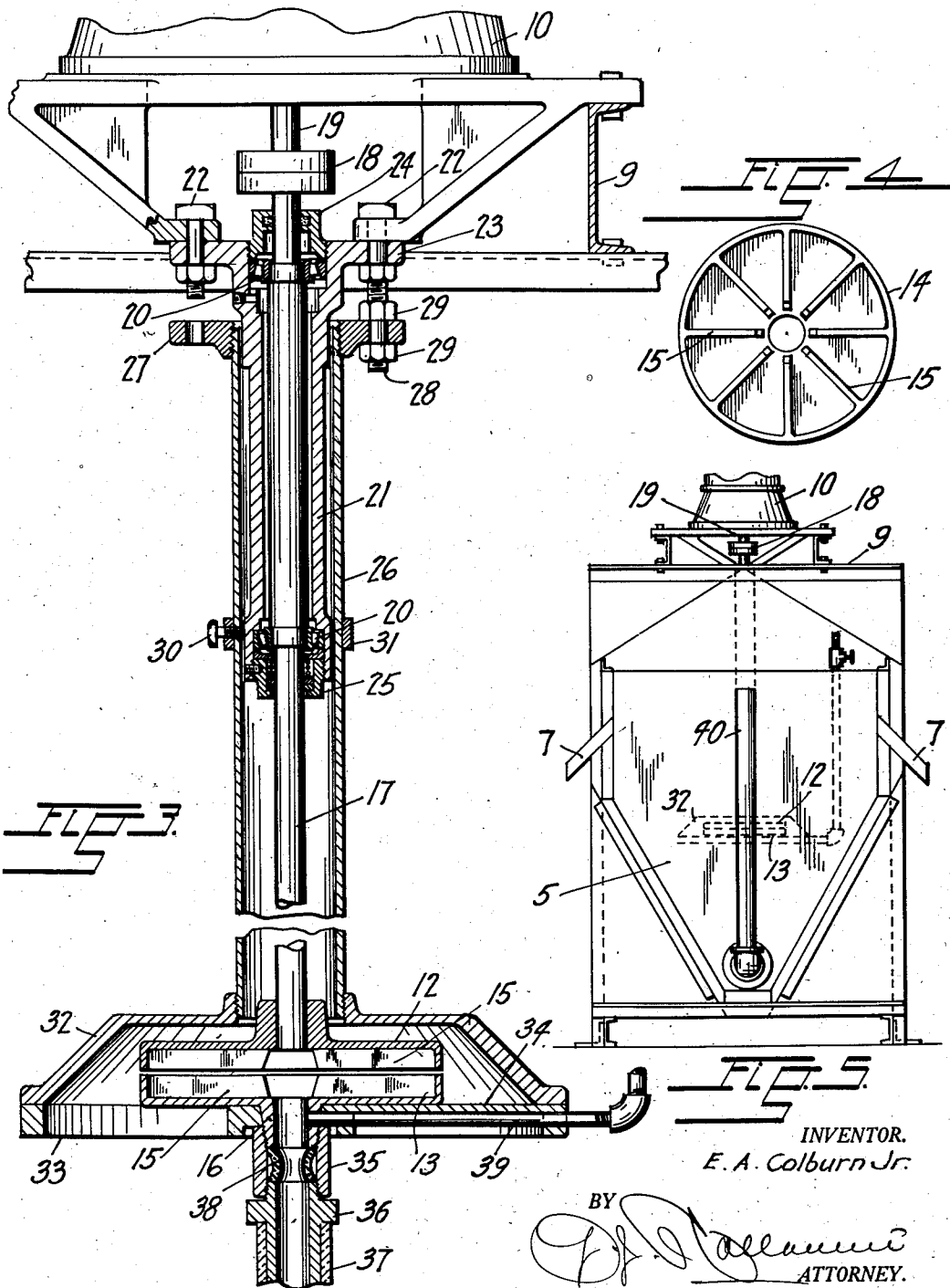
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UNITED STATES PATENT OFFICE

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MIXING APPARATUS

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to Denver Patent Company, Denver, Colo.

Application March 26, 1927, Serial No. 178,624
Renewed February 11, 1935

10 Claims. (Cl. 259-96)

My invention relates to apparatus for the separation of ore by flotation and it is an object of the invention to provide mechanism for the introduction of material to be treated, below a definite liquid level in a spitzkasten or other suitable vessel, and subjecting it there to a scouring and mixing action which causes the material to readily separate into its metallic constituents which subsequently rise to the surface of the liquid, and the silicious gangue which settles to the bottom of the vessel.

Another object is to provide a mechanism by which the above stated actions are accomplished without undue agitation of the liquid in the vessel which might detrimentally interfere with the separating process as for example by the formation of a vortex from the rotary movement of a part of the element included in the apparatus by which the scouring and mixing action is produced.

Another object of the invention resides in providing a mechanism of the above described character which in its entirety and as a single unit can be removed from the spitzkasten and subsequently replaced without interfering with the operation or without the necessity of emptying the vessel in which it is installed, this being of particular value in that it facilitates adjustments and repairs.

Another object is to provide a mechanism for admitting the material to the spitzkasten and scouring and mixing the same at a pressure less than atmospheric, which mechanism by a simple adjustment may be employed to remove the settled solids from the bottom portion of the vessel.

A further object is to provide in a mechanism of the above described nature, means for aerating the material thereby aiding in the separation of its values from the gangue and still other objects reside in details of construction and novel and advantageous arrangements and combinations of parts, as will be fully disclosed in the course of the following detailed description.

It is to be noted that although the invention is particularly adapted for use in the separation of ores by the flotation process, it may also be used to advantage in other processes requiring a combined agitating and aerating action as for example the process of extracting metals from their ores by cyanidation.

An embodiment of the invention has been illustrated in the accompanying drawings in the several views of which like parts are similarly designated and in which

Figure 1 represents a partially sectional eleva-

tion of two spitzkastens to which the invention is applied,

Figure 2 is a top view of the same,

Figure 3, an enlarged sectional elevation of the agitating and aerating mechanism of the invention, parts of the same having been broken for lack of space,

Figure 4, a face view of one of the members of the scouring and mixing element included in the mechanism, and

Figure 5, an end elevation of the apparatus looking in the direction of the arrow A in Figure 1.

Referring further to the drawings the numerals 5 designate two spitzkastens of conventional form and construction provided with a weir 6 to determine the level of their liquid contents, with overflow aprons 7 for the removal of the floating minerals from the liquid level, and with openings 8 for the admission of the material to the lower portions of the vessels.

Mounted upon a superstructure 9 centrally above the spitzkasten, are motors 10 for the operation of the mixing and aerating mechanisms. These mechanisms are the same for each spitzkasten and a description of one will suffice to give a clear understanding of their construction and operation throughout the apparatus.

It is to be understood that while the drawings show two spitzkastens in cooperative relation to each other, a single vessel or more than two vessels may be used according to the nature of the material to be treated and the desired capacity of the plant, without departing from the spirit of the invention.

The mechanism above referred to comprises two cup shaped members 12 and 13 placed horizontally and spaced face to face in opposite relation, and axially, in vertical alinement. Each member has inside a circular rim 14 a series of equidistantly spaced radial blades 15 and the lower member 13 which is stationary with relation to the other has a central hollow hub 16 through which the material is admitted to the vessel.

The upper member 12 is fastened at the lower end of a shaft 17 which by means of a coupling 18 is connected with the shaft 19 of the respective motor. The shaft 17 is supported against lateral displacement in two roller bearings 20 at opposite ends of a long tubular sleeve 21 which by means of bolts 22 is suspended from the structure on which the motor is mounted.

The sleeve has for this purpose a flange 23 and it is provided with stuffing boxes 24 and 25 to prevent liquid or other matter from splashing

into its ends. A casing **26** concentric to the sleeve, carries at its upper end, a flanged collar **27** for the application of bolts **28** by means of which it is suspended from the superstructure or from the flange at the upper end of the sleeve. The bolts extend through holes in the collar and they are provided with nuts **29** above and below the flange of the same so that the casing may be adjusted vertically to thereby vary the space between the stationary and movable agitating members **12** and **13**.

A set screw **30** extending through a threaded aperture in a reenforcing ring **31** of the casing, aids in centering it with relation to the bearing sleeve.

Fastened at the lower end of the tubular casing is a hood **32** which covers and encloses the agitating element of the apparatus, consisting of the two members **12** and **13** described hereinbefore, and secured at the lower edge of this hood, is a ring **33** which has an inwardly projecting arm **34** upon which the stationary lower member of the element is supported. The arm has to this end, an opening to receive the hub of the member **13**, and the projecting portion of the hub is screw-threaded for the application of a coupling **35** by means of which it is fastened to the hollow plug **36** of a flexible conduit or hose **37** through which the material is admitted to the hub.

A washer **38** of rubber or other suitable material restricts the opening to the hollow hub of the stationary member and thereby produces a partial vacuum, which in turn produces a suction that assists in drawing the pulp upwardly through the conduit **37**, and renders the minerals and the gangue more susceptible to the action of the water and the oil respectively.

The hollow hub of the stationary member of the agitating element has a transverse aperture in which is fitted the end of a pipe **39** which likewise is supported on the arm of the ring at the lower edge of the hood, and which connects with the atmosphere and can be throttled as the conditions of the ore demand.

The ends of the flexible intake conduits of the agitating mechanisms in the spitzkasten extend loosely through the inlet openings **8** in the bottom portions of the same and the conduit of the spitzkasten which is first in the series connects with a stand pipe **40** of a feed box or other source from which the material to be treated is obtained.

In this connection it is to be understood that if so desired the material may be fed directly into the first spitzkasten and from one spitzkasten to another through the connecting openings in which case the ends of the suction conduits would be placed in the lower portions of the respective spitzkastens to withdraw the material from the bottom thereof.

In the operation of the apparatus the material fed through the pipe **40** enters the conduit **37**. Rotation of the upper member of the agitating element by the respective motor, creates a partial vacuum, regulated by the distance between the members of the element, which draws the material through the conduit into the space between the members where it is mixed and scoured.

The air entering through the pipe **39** is disseminated through the material which passes around the lower edge of the hood **32** into the vessel.

The colloidal envelopes of the metallic particles in the material are expanded by the partial vacuum and the particles are smoothed and

polished with the result that they repel the water in the pulp and acquire an affinity for the oil or other flotation agent supplied to the vessel. The buoyant metallic particles aided by the finely divided air and the oil, ascend to the surface of the liquid in the vessel where they congregate in a froth or film which is removed across the overflow.

The silicious contents of the material at the same time sink to the bottom of the vessel and are withdrawn through the conduit of the next spitzkasten in which the above described operation is repeated.

The gangue in the last spitzkasten of the series or that remaining in the other spitzkasten may be loosened and removed from the bottom thereof by withdrawing the ends of the flexible conduits from the openings **8** in which they are loosely disposed, and placing said ends in the settled material when by the partial vacuum constantly maintained by continuous rotation of the shaft **17**, the settled mass is loosened and brought into circulation in the vessel.

The last mentioned feature of the invention is of considerable value since the gangue settling into a cake at the bottom of the spitzkasten, particularly when the operation of the apparatus is discontinued, interferes with the separating process and clogs up the communicating ports between the vessels and ordinarily can be removed only at an expenditure of much time and labor.

The coarse gangue is usually removed from the last spitzkasten through a valve-controlled outlet **45**.

It is to be observed that the enclosure for the rotary parts of the mechanism, including the casing **26** and the deflecting hood prevent formation of a vortex by the rotary motion which otherwise would seriously interfere with the upward movement of the mineral particles and in general would impede the separating process. The hood moreover aids in scouring and disseminating the metallic particles by obstructing their outward movement under centrifugal force and deflecting them downwardly to enter the liquid in the spitzkasten across the lower edge of the hood.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point, an agitating and suction element in the vessel below that point, a conduit for feeding material to the element, and having its mouth outside the vessel, the conduit being adjustable for placing its mouth inside the vessel for the removal of settled matter and means to admit air to the material.

2. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point and having an intake opening below that point, an agitating and suction unit suspended in the vessel beneath the liquid level, a conduit for feeding material to the unit, extending loosely through the intake opening and means to admit air to the material.

3. In flotation apparatus, a vessel adapted to be filled with a liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member and a rotary member in cooperative relation to each other, a motor outside the vessel in driving connection with the rotary member, an enclosure closed at its top for the rotary parts of the element, extending below the liquid level, said enclosure having an

opening for the discharge of material into the liquid in the vessel, and a conduit for feeding material to the element and means to admit air to the material.

5 4. In flotation apparatus, a vessel adapted to be filled with a liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member and a rotary member in cooperative relation to each other, a motor 10 outside the vessel in driving connection with the rotary member, an enclosure for the rotary parts of the element, extending below the liquid level, including a tubular casing and a hood at the lower end thereof, the hood being closed at its 15 top and open at its bottom, and a conduit for feeding material to the element and means to admit air to the material.

5 5. In flotation apparatus, a vessel adapted to be filled with a liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member, an upright rotary shaft, a member on the shaft in cooperative relation to the stationary member, a motor outside 20 the vessel in driving connection with the shaft, a casing enclosing the shaft, a hood at the lower end of the casing, over the cooperative members of the unit, and a conduit for feeding material to the members and means to admit air to the material.

30 6. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member, an upright rotary shaft, a member on the shaft in cooperative relation to the stationary member, a motor outside the vessel 35 in driving connection with the shaft, a bearing sleeve for the shaft extending into the vessel, a casing enclosing the bearing sleeve and the shaft, a hood at the lower end of the casing over the cooperative members of the unit, a conduit for 40 feeding material to the members and means to admit air to the material.

45 7. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member, an upright rotary shaft,

a member on the shaft in cooperative relation to the stationary member, a motor outside the vessel in driving connection with the shaft, a casing enclosing the shaft, a hood at the lower end of the casing, over the cooperative members of the unit, 5 a support on the hood for the stationary member, a conduit for feeding material to the members, connected with the stationary member on the support and means to admit air to the material.

8. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member, an upright rotary shaft, 10 a member on the shaft in cooperative relation to the stationary member, a motor outside the vessel in driving connection with the shaft, an enclosure for the rotary parts of the unit inside the vessel, a conduit for feeding material to the unit, the stationary member and the conduit being supported by the enclosure and means to admit air 20 to the material.

9. In flotation apparatus, a vessel adapted to be filled with liquid to a certain point, an agitating unit in the vessel below that point, including a stationary member, an upright rotary shaft, 25 a member on the shaft in cooperative relation to the stationary member, a motor outside the vessel in driving connection with the shaft, an enclosure for the rotary parts of the unit inside the vessel, a conduit for feeding material to the unit, and a 30 pipe for admitting air to the material, the stationary member, the conduit and the pipe being supported by the enclosure.

10. Flotation apparatus comprising in combination a flotation cell, a rotary driving shaft extending downwardly into said cell, an impeller 35 having agitating blades and a top cover rotatably carried by said shaft, a stationary sleeve surrounding said shaft and extending from a point adjacent said impeller to a point above the pulp and froth level in said cell, a discharge outlet for 40 said cell, and a tube leading to said impeller from the point of pulp entrance to said cell for delivering pulp to said impeller.

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