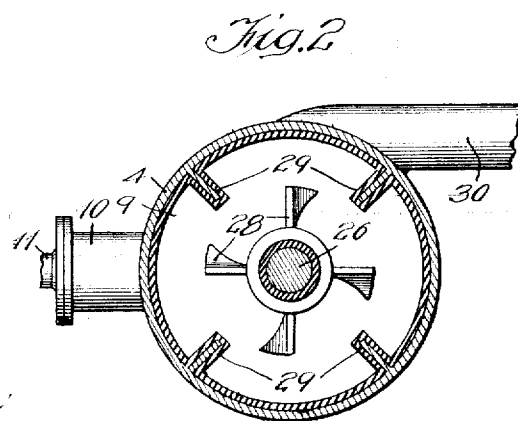
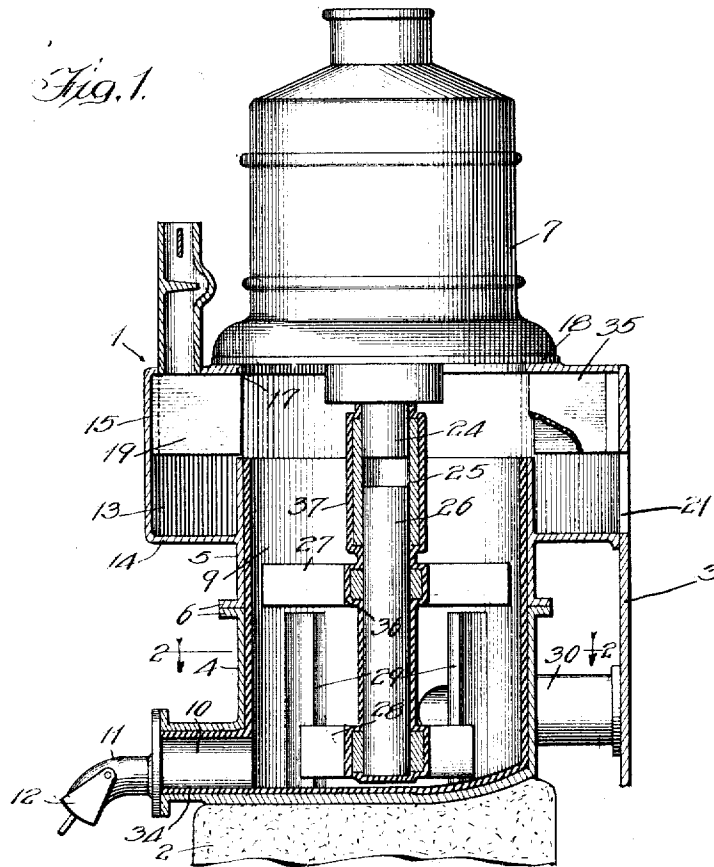


C. F. SHERWOOD.
AGITATING MACHINE.
APPLICATION FILED APR. 28, 1919.

1,381,673.

Patented June 14, 1921.
2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 3

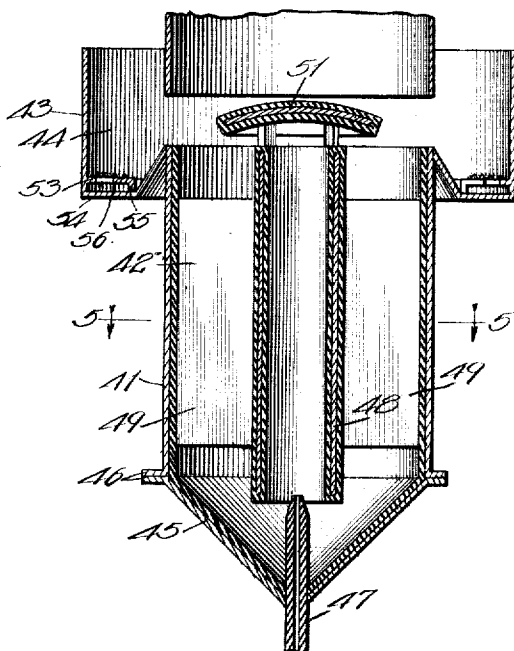


Fig. 4

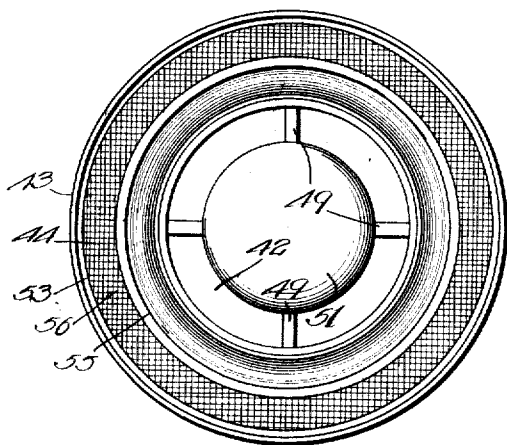
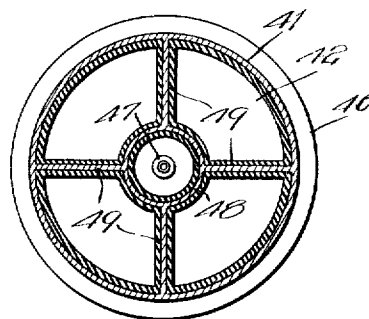


Fig. 5



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UNITED STATES PATENT OFFICE.

CHARLES F. SHERWOOD, OF SALT LAKE CITY, UTAH, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF NINETY PER CENT. TO GEORGE T. HANSEN, OF SALT LAKE CITY, UTAH, AND FIVE PER CENT. TO THOMAS A. RYAN AND FIVE PER CENT. TO B. O. JONES, BOTH OF DENVER, COLORADO.

AGITATING-MACHINE.

1,381,673.

Specification of Letters Patent. Patented June 14, 1921.

Application filed April 28, 1919. Serial No. 293,286.

To all whom it may concern:

Be it known that I, CHARLES F. SHERWOOD, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented a certain new and useful Improvement in Agitating-Machines, of which the following is a full, clear, concise and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to the art of mixing or agitating. While I shall describe the invention with special reference to a particular embodiment and a particular art, namely, mineral separation by flotation, I do not intend to limit the invention to the specific embodiments described nor to the particular art with which the said specific embodiments are concerned. The invention is peculiarly adapted to machines and devices through or in which a gritty material is handled or agitated and while the first and primary object is the provision of an improved protective lining or covering for the parts subject to the destructive erosion of the abrasive material which is treated, a further and more far reaching object is to improve the fundamental operation of mixing or agitating itself, based upon the yielding or impressionable and resilient character of the surfaces which engage the medium to be mixed or agitated.

I have discovered that in mixing or agitating a fluid medium composed of constituents of different inertia characteristics or different characteristics of fluidity, for example a finely divided solid such as a metal ore and a liquid such as water or a mixture of liquids such as oil and water with which the herein described particular embodiments of my invention are concerned, the impressionable and resilient character of the agitating members or surfaces promotes a more intimate and more efficacious mixture or mutual intermingling of the constituent particles than has heretofore been attained by any of the devices of the prior art with which I am familiar. I shall define for the purposes of the following specification and claims a fluid medium as a mass or body of particles all of such dimensions and of such relative freedom of motion with respect to each other

as to flow or move readily with respect to each other when subjected to the action of a stirrer or agitator. I do not intend to limit the phrase solely to liquids, or gases or vapors or solutions or mixtures containing liquids, gases or vapors.

More particularly, my invention is especially applicable to agitating machines of the type commonly employed in the oil flotation process of concentrating ores. As usually constructed, such machines comprise a casing usually having a separate metallic lining, within which is arranged a mechanically operated impeller or agitator, the function of the machine being to continuously agitate a contained liquid which carries a finely pulverized ore such as a gold bearing quartz. The liquid carrying the quartz consists of water with a relatively small percentage of oil, and in some instances an acid re-agent such as sulfuric acid.

The oil has a preferential affinity for the metallic or metalliferous parts of the ore, which phenomenon is taken advantage of in raising the ore particles to the surface by flotation. The general practice is to create a froth or foam bearing the oil treated metallic or metalliferous particles which froth or foam may be brushed off or removed. With this particular phase of the flotation process my invention is not immediately concerned as my invention relates to the stage of mixing or agitating and not the froth removal.

Agitating machines of the general type, with which my invention is concerned, function to secure an intimate commingling of the pulverized ore with the flotation liquid by thoroughly agitating the pulp at a high speed, with the result that the continual impingement of the grit particles of the ore against the interior parts of the machine, particularly the metallic lining and the impeller soon destroys these parts by abrasion, and the machine must either be repaired or replaced.

My invention provides first a protective covering for the metallic lining and the other metallic parts exposed to the impingement of the ore particles, which protective covering is of such a nature that the hard particles in the pulp do not abrade or cut this away, and second, an impressionable elastic

surface which permits the particles of greater inertia or of a lower degree of fluidity to momentarily embed themselves in said surface whereby a greater area of contact and a longer period of engagement are permitted with the agitating surface to the end of greater relative motion between the particles and better mixing or distribution of the constituents evenly throughout the mass; and third a medium for holding and distributing certain of the constituents as for example the oil, all to the great improvement of the operation of the machine and the carrying out of the process of mixing which is particularly disclosed and claimed in my copending application Serial # 462,354 filed April 18, 1921. Contrary to the general supposition that an extremely hard metallic lining would be more capable of withstanding this erosion, I find a resilient lining, preferably one of rubber, to be more durable under the abrasive action of the grit particles. This apparent anomaly I attribute to the fact that the rubber, or other resilient material yields to the impact of the abrasive particles, without receiving injury, whereas the metallic lining, being incapable of yielding at each point of impact, suffers abrasion. A further utility of the rubber lining is that of protecting the metallic surfaces in the agitator against the corrosive action of the acids, which are frequently mixed in the pulp to improve flotation. This rubber lining is applied to the metallic surfaces to be protected in the form of a relatively thick layer of rubber which is preferably vulcanized directly upon the metallic surfaces, although it will be apparent that the lining can be retained by cement, or by any other suitable means.

I have found also that under continued operation, machines of the prior art rapidly lose in effectiveness and efficiency. I have found that this is due to abrasion causing changes in the clearances and changes in the shape of the impeller and other surfaces. The preservation of the shape of such surfaces by the rubber coating of my invention prolongs the life and efficiency of such machines.

In the accompanying drawings, I have illustrated a preferred embodiment of my invention as applied to agitating machines used in the flotation separation process of concentrating ores, but it will be apparent that the scope of my invention is not confined to this particular use, but extends to the protection of any machines or devices subject to erosion by moving particles of abrasive material or material having an abrasive action owing to high velocity.

In the drawing,

Figure 1 is a vertical sectional view of a conventional agitating machine provided with a resilient lining and accessible resilient lining;

Fig. 2 is a transverse sectional view of the above figure taken on the line 2—2 thereof;

Fig. 3 is a vertical sectional view of an air operated agitating machine, showing the application of the resilient lining thereto;

Fig. 4 is a plan view of the same;

Fig. 5 is a transverse sectional view taken on the plane of the line 5—5 of Fig. 3.

I shall give a brief description of the structure and operation of a conventional type of agitator in order that a better understanding may be had of the detrimental abrasive action upon the interior metallic surfaces of the agitator, as heretofore constructed, caused by the impingement of the ore particles thereon, and in order that I may convey more clearly the manner in which the impressionable elastic or resilient surfaces of my invention improve the fundamental operation of mixing, agitating or distributing the constituent particles as thoroughly as possible.

Referring to Fig. 1, the agitating machine broadly designated 1 is supported upon a concrete pedestal 2 or other suitable support, in proximity to the separating box or spitzkasten 3, between which and the agitating machine the pulp is circulated. I have not illustrated the formation of the separating box, as this device is not related to the present invention. The main structure of the agitator 1 comprises the lower casing 4, the upper casing 5, these two casings being joined by the flanges 6—6, and the motor housing 7 superimposed upon the upper casing 5. The lower casing 4 is cylindrical in shape and with the reduced cylindrical portion of the upper casing 5, defines a cylindrical agitating chamber 9. The bottom of the lower casing 4 is formed with a duct having a drainage spout 11 extending therefrom and provided with a swinging valve 12 normally closing said spout and providing a drainage outlet for flushing out the agitating chamber when cleaning the machine.

An annular pulp collecting chamber or trough 13 surrounds the upper part of the agitating chamber 9, this chamber being formed by the radially extending wall 14 projecting from the body of the casing 5, and the vertical wall 15, integral with the web 14 and encircling the chamber 13. The vertical wall 15 of the chamber 13 is provided with an inwardly turned flange 17 upon which rests the base flange 18 of the upright motor 7. The agitating chamber 9 extends up to a point approximately midway of the depth of the chamber 13, and into the trough thus formed between the wall of the agitating chamber and the vertical wall 15 is expelled the froth and pulp after agitation in the chamber 9. Disposed about the interior of the chamber 13 are a plurality of radially extending baffles or plates 19 which are

adapted to arrest the circulatory motion of the pulp or froth as it emerges from the agitating chamber 9 and permit it to settle quiescently into the chamber 13 from whence it flows out through the opening 21 and down into the separating box 3.

A shaft 24 from the motor 7, extends down into the agitating chamber and has connection through the coupling 25 with the impeller shaft 26. This impeller shaft supports an upper agitator 27 and a lower agitator 28, which preferably take the form of a series of radiating arms, four in number, and which are rotated at a relatively high speed by the motor 7 to secure a thorough agitation of the pulp. The lower impeller arms 28 are relatively short in order to just clear a series of baffles 29 which extend inwardly from the walls of the casing 4, as clearly shown in Fig. 2. The upper impeller arms 27 extend outwardly with just sufficient clearance for safety between the ends thereof and the interior surface of the chamber 9. The lower impeller arms 28 are slightly dished or curved as clearly shown in Fig. 2, to impart an upward propulsion to the pulp in addition to the circulatory agitation of the pulp.

The pulp enters at the lower end of the agitation chamber 9 through the conduit 30, which leads up from a relatively low point in the separating box 3. By the operation of the agitator a circulation of pulp is built up between the separating box 3 and the agitator 1, the pulp flowing up through the conduit 30 into the agitating chamber 9, out over the top thereof into the trough 13, and out through the port 21 back into the separating box 3. When the pulp is discharged into the separating box 3 after agitation, the metalliferous matter is held in suspension by the adhesion of the oil particles while the gangue or refuse precipitates to the bottom of the separating box, where it is recirculated for the further extraction of metals.

It will be immediately apparent that a very destructive erosion of any unyielding surface, subject to the impingement of the rock and metal particles is bound to ensue from the violence of the agitation and the speed of rotation of the impellers, which ranges from 500 to 1,000 r. p. m. Replaceable metallic linings have been the only expedient heretofore practised for taking care of this condition, but obviously the replacing of these linings involves such inconvenience and expense in addition to the loss in shutting down the machine, that they have become practically intolerable. These, furthermore, are impracticable for protecting the surfaces of the impellers.

The resilient lining which I propose using preferably consists of a layer of rubber 32 of approximately $\frac{1}{2}$ or $\frac{3}{4}$ " thickness, which is vulcanized about the interior of the agitating chamber 9. The projecting baffles 29 must

also be protected with a rubber covering, which may be accomplished by stretching the main lining 32 to conform to the shape of the baffles and vulcanizing the rubber in place, or by vulcanizing separate strips to the surfaces of the baffles and then vulcanizing the strips to the main lining 32 to form a homogeneous lining, or by any other suitable method. The interior of the discharge duct 10 is also protected by a rubber lining 34, which may be applied in the same manner. The baffles 19, which are adapted to arrest the circulatory motion of the pulp, are also provided with a layer of rubber upon the sides exposed to the impinging particles of ore, as indicated at 35. I find that the metallic surfaces of the impeller arms are subject to a very rapid abrasive action and accordingly I sheath these in rubber also, together with the impeller shaft 26, as indicated at 36. The rubber sheathing for the impeller arms may be applied as previously stated, or it may be molded in the proper shape prior to being vulcanized to the impellers and thereafter vulcanized to the tubular sheath inclosing the impeller shaft 26.

The efficacy of this protective layer of rubber may be illustrated by reference to a specific instance in which an agitating machine so protected was employed for agitating a pulp consisting of quartz containing metallic particles in the percentage of one of solid to three of water, and after months of handling pulp of this character showed no visible signs of abrasion. With the usual metallic construction, this severe service would have necessitated a renewal of the lining at least every few months. I found also that for the expenditure of a given amount of energy the yield of ore was markedly increased. I attribute this to two fundamental causes,—first, the lower coefficient of friction caused by the elimination of wearing and greater freedom of motion and second to the greater relative motion between particles and more thorough application of the oil to the metal particles caused by the greater area of contact which is secured when a particle embeds itself momentarily in the impressionable resilient surface of the rubber. A further utility of this rubber lining is that of protecting the interior of the agitator from the corrosive action of the acids commonly added to the pulp.

In Fig. 3 I have shown my invention applied to an air agitated flotation machine. In this arrangement compressed air injected into the pulp, is used as the agitating agency. The casing comprises the main cylindrical shell 41, forming an agitating chamber 42, and the enlarged cup-shaped portion 43, forming a pulp collecting trough, or launder 44. At its lower end the casing 41 carries a conical chamber 45, secured thereto by the

flanges 46. A compressed air nozzle 47 extends up through the conical member 45, and opens into a central agitating tube 48, which is supported in the agitating chamber 42 by wings 49 extending inward from the casing 41, as clearly shown in Fig. 5. A deflecting cap 51 surmounts the agitating tube 47 and functions to deflect the agitated mass of pulp, as it is impelled upward through the tube 48, out over the top of the tube and back into the main agitating chamber 42. The enlarged casing 43 is provided with a small inwardly extending flange 53, adjacent the floor of the trough 44, and co-operating with this flange is a ring 54, which is supported above the floor of the trough by a down-turned flange 55, thereby forming an annular conduit 50 in the bottom of the trough. The edge of the ring 54 is spaced from the flange 53 to afford an annular opening from the conduit into the trough. This opening is covered by a ring of thin fabric 56 which sustains the froth and keeps it out of the conduit 50. Air under a slight pressure is admitted to the conduit 50, and this air, issuing through the fabric ring 56, blows the froth out of the top of the trough 44 as fast as it settles down along the inclined face of the trough, from the lip of the agitating chamber 9. A ring 58 is supported in the upper part of the enlarged casing 43, for the purpose of preventing the froth from falling back into the agitating chamber 42. The froth collecting receptacle and the circulatory system for charging the agitation chamber with pulp are not shown as they have no direct bearing upon the present invention.

The entire inner surface of the agitating chamber 42 is provided with a protective lining of rubber 59, applied in practically the same manner as just described of the mechanical type of agitator. The agitating tube 48 is completely lined, both inside and out with a layer of rubber 61, together with the wings 49, which support the same, and the deflecting cap 51 at the top of the tube. The compressed air nozzle 47 is either constructed entirely of rubber, or is sheathed in rubber, as it is also subject to abrasion by the pulp descending into the bottom of the conical chamber 45. If deemed desirable, the interior of the trough 44 and the deflecting ring 58 may also be provided with a protective layer of rubber, to protect these surfaces from the metalliferous particles in the froth, and from small quantities of pulp which may be ejected from the trough.

The essence of the invention resides in the impressionable resilient rubber surfaces which have relative motion with respect to the particles composing the fluid medium or mass. While this characteristic is fundamentally responsible for preservation of the parts against wear it is also responsible for

a peculiar action which greatly improves the operation or action of mixing or agitating.

During the relative motion between the rubber surface and the fluid mass the particles of oil to be distributed come into contact with the rubber surface, so that for each contact of a globule of oil with the rubber there is a wetting of the rubber surface with oil, whereby for a brief period of time at least there is a film of oil upon a part of the surface. Thereafter let us assume that a particle of metal or metalliferous ore strikes the surface at the point where the film of oil is formed. The ensuing contact between the heavy particle of metal or ore, causes a relatively greater wetting of the surface of the particle with the oil because the rubber surface permits the particle to embed itself momentarily. As soon as the impact of the particle is taken up the particle is thrown off because of the resilient character of the rubber. The surface is thus self cleaning and always ready to repeat the operation.

I find that the oil has a tendency to adhere quite firmly to the rubber surface until it is taken up by the metal or ore particles and this phenomenon assists further in the better distribution of the oil to the metal or ore particles although this is not the sole reason as I have above indicated for the improved efficiency but is merely a further favorable action in the practice of agitating pulp and oil. This surface is primarily resilient and preferably rubber, though not necessarily so, as any other suitable yielding material might be employed. Pure rubber may be used, or any suitable combination of rubber and fabric.

I do not wish to limit the invention to the use of rubber. While to my present knowledge this is the only substance which will secure the desired effect or effects I intend to include such substitutes or equivalents as embody the characteristics which are required to secure the fundamental action which I have disclosed. I employ the phrase "rubber like" to designate broadly a substance having the desired characteristics which rubber provides.

It is immaterial whether the agitating surface moves against the fluid medium or mass or vice versa. Both actions are illustrated in the above described embodiments.

Though I have described vulcanizing as being the preferred method of attaching this rubber to the metallic surfaces, particularly to the impeller arms owing to their high rotational speed, it will be obvious that cement or any suitable means of attachment may be employed.

What I claim as new, and desire to protect by Letters Patent is:

1. In a device of the class described an agitating member adapted to have violent agitating impact with a fluid mass only, said

members having an impressionable resilient impact surface for engaging with the particles of said fluid mass.

2. An agitating member for agitating a fluid mass consisting of particles of different inertia characteristics, said member having a yielding elastic impact surface which is brought into agitating engagement with the fluid mass.

3. An agitating member for bringing into intimate engagement the various constituents of a fluid mass consisting of particles of different degrees of fluidity, by repeated impact, comprising a soft rubber impact surface adapted to have agitating contact with said fluid mass.

4. In a device of the class described an impacting agitating member of rubber like characteristics adapted to have free impacting agitating engagement with the particles of a fluid mass to be agitated.

5. In a flotation machine an agitator member having a surface for agitating engagement with a body of pulp said surface being yielding and elastic to permit the solid particles of the pulp to embed themselves momentarily only whereby the area of contact of the particle with the surface is increased and whereby the surface is preserved against wear or erosion.

6. In a flotation machine an agitator comprising a central hub and radial arms said arms having faces adapted to contact with the solid particles of the pulp when said agitator is rotated, said faces comprising impressionable resilient material.

7. In a flotation machine an agitator comprising a metallic frame consisting of a hub and radiating arms and a covering of soft resilient rubber like material over said arms.

8. In an agitator for agitating a fluid mass consisting of particles of material of different freedom of motion, a member having a yielding elastic impacting facing adapted to have impacting and agitating contact with the particles of said mass indiscriminately, said facing comprising a relatively impervious surface and a yielding elastic body back of the same such as is provided by a relatively thick body of soft tough rubber.

9. In a flotation separation machine, an agitating chamber adapted to contain a liquid solution of abrasive material to be agitated, agitating means in said chamber, and a resilient protective lining of rubber or the like about the interior of said chamber for preventing abrasion or corrosion by said abrasive solution said lining of rubber providing a yielding elastic contact surface for agitating contact with the abrasive material to be agitated.

10. In a flotation separation machine, an agitating chamber adapted to contain a

liquid solution of abrasive metalliferous particles to be agitated, a mechanical agitator immersed in said liquid solution, and a protective liner of rubber or similar resilient material covering the interior surfaces immersed in said metalliferous solution, to prevent abrasion or corrosion thereof said rubber liner providing a yielding elastic contact surface for agitating contact with the particles to be agitated.

11. In a flotation separation machine, an agitating chamber adapted to agitate a contained liquid emulsion of metalliferous particles, agitating surfaces disposed angularly in said agitating chamber below the depth of immersion, a mechanical agitator disposed in said agitating chamber, said agitator comprising a driving shaft and a plurality of agitating arms immersed in said liquid emulsion, a resilient protective liner of rubber or the like supported on the exposed surfaces of said agitating chamber and said agitating surfaces and a similar covering of rubber or the like molded to said agitating arms.

12. In an agitating machine for agitating an ore bearing pulp, an agitating chamber, means for agitating the pulp in said chamber, and a protective lining of rubber vulcanized about the interior of said agitating chamber for protecting the same against the corrosive and abrasive action of said pulp said lining of rubber providing a yielding elastic contact surface for agitating contact with the pulp.

13. In a flotation separation machine, an agitating chamber adapted to agitate a contained liquid emulsion of metalliferous particles, baffles projecting into said chamber, a vertical agitator shaft extending into said agitating chamber, agitating arms adapted to be rotated by said shaft, a lining of rubber vulcanized about the interior surfaces of said agitating chamber below the depth of immersion, a covering of rubber vulcanized to said baffles, and a similar covering of rubber molded to said agitating arms for protecting the same against the abrasion and corrosion of said liquid emulsion.

14. In a flotation cell, a vertical, circular agitating chamber adapted to contain a quantity of liquid emulsion of metalliferous particles adapted to be continuously agitated therein, an intake conduit opening into the lower part of said agitating chamber, an overflow discharge outlet leading from the upper part of said agitating chamber through which the froth or pulp is discharged, a vertical agitator shaft extending concentrically into said chamber, a plurality of agitator arms projecting from said shaft, a plurality of baffles extending inwardly from the walls of said chamber and co-operating with said agitating arms, a resili-

ent protective liner of rubber covering the interior of said agitating chamber, a rubber coating covering the exposed surfaces of said baffles, and a similar rubber covering
5 molded about said agitator arms and sheathing said agitator shaft to prevent abrasion and corrosion by said liquid emulsion.

15. In an agitating machine for agitating an ore bearing pulp, an agitating chamber,
10 impeller members in said chamber for agitating and circulating said pulp, baffle members in said agitating chamber, and a protective lining of rubber vulcanized upon the surfaces of said chamber and said baffle

members and molded on said impeller for
15 preventing abrasion thereof by said pulp.

16. In an agitating machine for agitating an ore bearing pulp, an agitating chamber, impeller members in said chamber for agitating and circulating said pulp, and a protective lining of rubber vulcanized to the
20 surfaces of said agitating chamber and said impeller for protecting the same against the corrosive and abrasive action of said pulp.

In witness whereof I hereunto subscribe
25 my name this 17 day of March, 1919.

CHARLES F. SHERWOOD.