No. 624,684. Patented May 9, 1899.

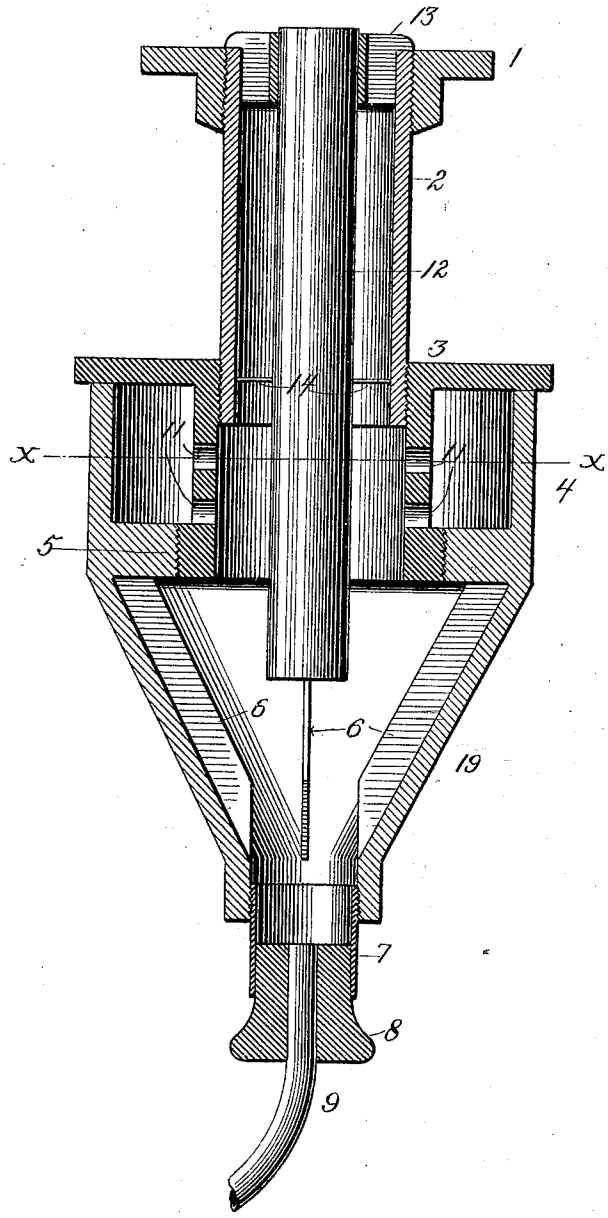
R. H. RICHARDS.

HYDRAULIC SEPARATING APPARATUS AND METHOD OF SEPARATING.

(Application filed July 20, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses
Grenville Lewis Jr.
J. M. Poul

Inventor:
Robert H. Richards,
by Dodger Sons,
Attorneys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 2.

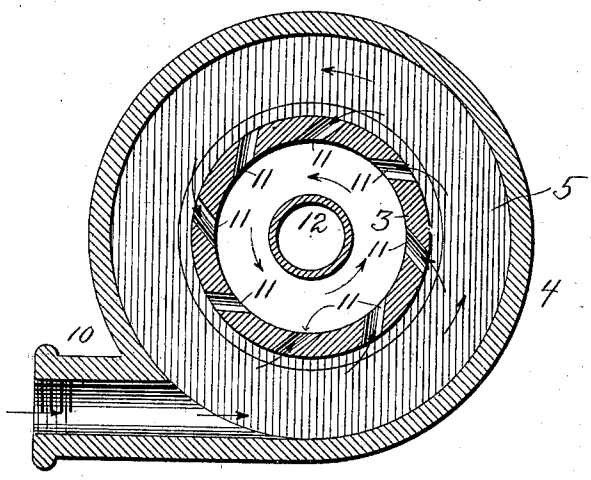


Fig. 3.

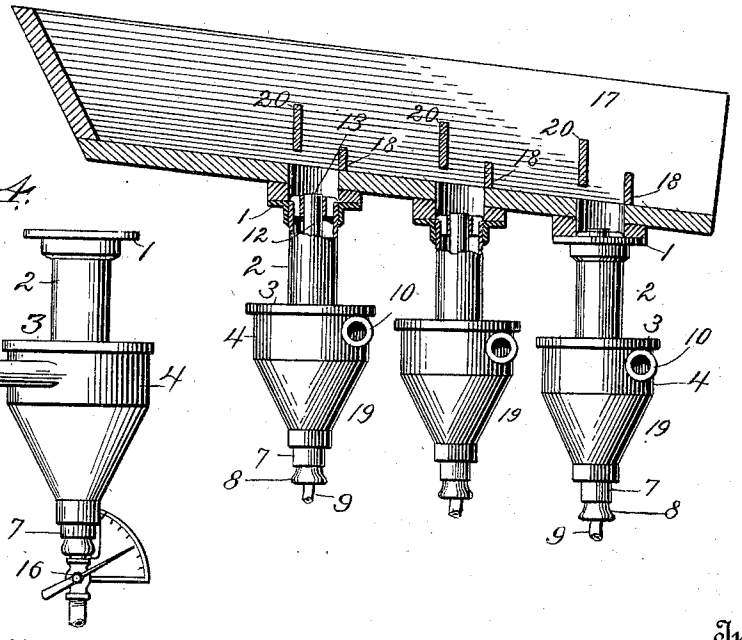


Fig. 4.

Witnesses
Grenville Lewis Jr.
J. M. Pond.

Inventor:
Robert H. Richards,
by Dodge Sons,
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ROBERT H. RICHARDS, OF BOSTON, MASSACHUSETTS.

HYDRAULIC SEPARATING APPARATUS AND METHOD OF SEPARATING.

SPECIFICATION forming part of Letters Patent No. 624,684, dated May 9, 1899.

Application filed July 20, 1898. Serial No. 686,455. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. RICHARDS, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Hydraulic Separating Apparatus and Method of Separation, of which the following is a specification.

My invention pertains to hydraulic separating apparatus such as is employed in the separation or recovery of fine ore too small for successful grading by sieves or screens. In this class of separators two distinct currents of water are caused to act in conjunction, the first to convey the ore along a trough or conduit containing pockets or wells and the second rising in the pockets to prevent descent of any particles of less than the predetermined weights to which the currents in the respective pockets are gaged or proportioned. In the practical use of such apparatus it is found that the ascending current in any given pocket does not maintain uniformity throughout the area of the pocket, but that it is often strong at one side and weak at the other, or that there will be ascending and descending currents side by side in the same pocket or well. My invention is designed to overcome this difficulty, or, in other words, to establish and to maintain at all times a regular and uniform current throughout the horizontal area of each well or pocket, the strength of such current being independently regulated for each, according to the separation to be effected therein.

Stated in general terms, the result mentioned is attained by imparting to the ascending water column of each well or pocket a spiral or whirling movement; and the invention consists, first, in the method of effecting the requisite motion and consequent separation, and, secondly, in the means whereby these effects are produced.

The apparatus is illustrated in the accompanying drawings, in which—

Figure 1 is a sectional elevation of one of the separating chambers, wells, or pockets; Fig. 2, a horizontal section on the line $x\ x$ of Fig. 1; Fig. 3, a view illustrating the manner of applying and using the device, and Fig. 4 a side elevation showing the regulating-cocks.

The details of construction may obviously vary, and it is to be understood that the form or embodiment shown is merely intended to illustrate the general idea in a form found simple and efficient, but that it is subject to such alterations or changes as would naturally fall within the province of the mechanic.

Referring first to Fig. 1, the construction of the pocket or well and the means for imparting rotary motion to the water will be explained, after which the operation of the separator as a whole will be pointed out.

1 indicates a flanged collar designed to be secured to the under side of a suitable trough or conduit, from which collar depends a pipe 2, preferably of circular cross-section.

3 indicates a tubular body having an internal diameter substantially equal to the external diameter of pipe 2, to the lower end of which latter it is united by a screw-joint, as shown, or in any other convenient manner.

The body 3 is formed or furnished with a broad horizontal flange at its upper end and may have a slight flange or enlargement at its lower end, as shown in Fig. 1, said lower end being externally threaded.

4 indicates a shell or casing, the upper portion of which is cylindrical in horizontal section, while the lower portion is conical or hopper-shaped. Projecting inwardly from the walls of shell or casing 4 at or about the point at which the taper or contraction begins is a horizontal shelf or ledge 5 of annular form, the inner edge of which is threaded to screw upon the threaded lower end of the tubular body 3. The parts are so proportioned that when they are properly screwed together the upper edge of shell 4 shall bear against the lower face of the upper flange of tubular body 3, a packing-gasket being introduced, if desired, to insure a water-tight joint.

The lower conical portion 19 of shell 4 is advisably provided with inwardly-extending wings or ribs 6, and its lower end is furnished with a nipple 7, into which is inserted a plug 8, carrying one end of a discharge-pipe 9, the other end of which is carried to any suitable delivery-point. This plug may be of wood, rubber, or other suitable material, or the pipe 9 may be connected with shell 4 in any other convenient manner.

The upper portion of shell 4 is provided with a tangential inlet-pipe 10 to admit water to the space or chamber above the shelf or floor 5 and between the inner body 3 and shell 4, as shown in Figs. 2 and 3.

The vertical walls of the inner shell or body 3 are provided with oblique or tangential passages 11, having the same general direction relatively to the axis of the well or pocket as has the inlet-pipe 10.

12 indicates a core arranged axially within the pipe 2 and extending downward from the top of said pipe to a point within the conical lower part of shell 4. This core is preferably made hollow; but in such case its ends are closed by heads having each a small perforation, so that water may enter and fill the core and prevent any tendency to lift or float from its proper position. The upper end of the core is provided with a spider 13, the radial arms or blades of which are of considerable depth or vertical measurement, though quite thin. These arms have extensions which rest upon the upper end of pipe 2, and thus serve to sustain the core, while the body portions of said arms bearing against the inner walls of pipe 2 serve to center the core and retain it in proper position. They also have the further purpose of overcoming the whirling or helical movement of the water column or body at or near the top of pipe 2, as do the ribs or wings 6 in the conical lower chamber. This core may be used or omitted; but the blades 13 are important. The core may be further steadied by radial braces 14 at or near the lower end of pipe 2; but these should be mere wires or thin stems to prevent interference with the water-currents.

Suitable cocks or valves 15 and 16 may, if desired, be provided to control and regulate the flow of water, and these are preferably provided with indicators movable over graduated arcs to indicate the extent of opening, the strength of current, and the size of the outlet-opening. A small-sized pipe will serve instead of valve 16.

It is of course apparent that instead of screwing the parts together they may be clamped or bolted and that by using suitable cores shells 3 and 4 could be cast as one integral body.

The devices being constructed as above set forth are placed in a series along the under side of a trough or conduit 17. A stream of water of proper volume and force is kept flowing constantly along this trough, carrying with it the ore to be treated. At each point where there is a well or pocket the main stream is met by an ascending stream from the pocket, which agitates the material carried by the main stream and holds up or prevents the fall of any particles of less than predetermined weight. Such particles as are too heavy to be sustained by the ascending current fall through the pipe 2 into the hopper or conical lower portion of shell or casing 4, whence they are carried off through pipe 9 and collected in a suitable receptacle. The ascending column of water is supplied through the tangentially-arranged pipe 10 to the space between the shells 3 and 4, wherein it takes on a rapid whirling motion, owing to the direction of the inflowing stream and the form of the space or chamber. From this space the water passes in a number of streams or jets to the inner space or chamber, of which pipe 2 forms an upward extension, producing therein a whirling or spirally-moving column. A portion of the water entering the inner chamber descends into the conical lower portion of the shell or casing, keeping said lower chamber always full of water and supplying the loss due to escape through pipe 9. As the aim is to permit such particles as reach the lower chamber to settle to the bottom and escape by pipe 9, the wings or fins 6 are provided to arrest or overcome the whirling motion of the water.

The inlet 10 is made of such size relatively to the passages 11 that there is always a pressure within the outer chamber, and hence the water flows equally through the several passages and insures a like pressure in all parts of the inner chamber or between pipe 2 and core 12, such result being further insured and maintained by the whirling motion maintained by the tangential direction of the jets or streams entering through the passages 11. The water within pipe 2 continues its rapid whirling motion until it encounters the radial arms or wings of spider 13, by which such motion is arrested, the water passing thence directly upward and acting in a most efficient manner upon the substances to be separated. A number of the pockets or wells being arranged in succession along the trough or conduit 17, the main stream is encountered at each by an ascending column of water, but the valves or cocks 15 are so adjusted that the strength of the vertical columns shall be progressively less toward the delivery end of trough or conduit 17. By this regulation of the strength of the several columns all except the heaviest particles are prevented from entering the first well or pocket, while those somewhat lighter may enter the next, and so on to the lightest particles to be recovered, which will enter the last pocket of the series.

If the trough 17 be inclined, as indicated in Fig. 3, it will be found advisable to place guards or ribs 18 in rear of each pocket to prevent the main current from passing too freely over the mouths or open ends of the pockets.

The manner of or means for producing the whirling motion in the pockets or wells may be varied without departing from the scope of my invention, though I deem the means shown and described peculiarly suited to the end in view. In other words, I believe myself to be the first to impart a spiral or whirling motion to an ascending column of water

acting in conjunction with a cross-stream to insure an equal and uniform upward pressure in all parts of the ascending column, and this I mean to claim without regard to the specific means employed.

Guards or baffle-plates 20 may be arranged above the wells or pockets to prevent the too-rapid passage of the ore-carrying current across them.

Having thus described my invention, what I claim is—

1. The herein-described method of separating or removing from a stream or current of water fine particles of matter contained therein, which consists in subjecting the carrying stream or current to the action of an ascending current of water having a whirling or spiral movement, whereby the pressure is rendered and maintained uniform throughout its entire area, the pressure or force of the ascending column being regulated to prevent the descent of any particles of less than predetermined weight.

2. The herein-described method of rendering uniform the pressure of ascending water columns of hydraulic separators and preventing counter-currents therein, which consists in imparting to said water column a whirling or circular motion throughout a portion of its height, and arresting such whirling motion at or near the point where it encounters the stream carrying the material to be separated.

3. In a hydraulic separator, the combination of a trough or conduit adapted to receive and direct the ore-carrying current; and a well or pocket beneath said conduit provided with a water-inlet and with means for imparting to the water within the well or pocket a whirling motion, said pocket opening directly into the base or bottom of the carrying trough or conduit, substantially as and for the purpose set forth.

4. In combination with a trough or conduit to receive and direct an ore-carrying water stream; a pocket or well beneath said conduit provided with a tangential water-inlet, whereby the water entering said pocket and ascending therein is caused to move in a circular or helical path, said pocket opening directly into the bottom of the carrying trough or conduit and serving to deliver its water in a path intersecting the main carrying-current.

5. In a hydraulic separator, the combination with a trough or conduit, of a well or pocket opening at its upper end into the bottom of the trough or conduit and consisting of a central pipe or chamber; an annular chamber encircling said central chamber; a series of tangentially-arranged passages extending through the wall between said chambers; and a tangential water-inlet for the outer chamber, whereby the water is caused to take on a whirling or helical motion in the outer chamber and is delivered to the inner chamber with a like whirling movement and with uniform pressure at all points.

6. The herein-described well or pocket for hydraulic separators consisting of pipe 2; flanged annular body 3; shell 4 provided with ledge 5 and fins or wings 6; tangential inlet 10; oblique passages 11; core 12; and blades 13.

7. The herein-described well or pocket for hydraulic separators consisting of pipe 2; flanged annular body 3; shell 4 provided with ledge 5 and fins or wings 6; tangential inlet 10; non-radial passages 11; and blades 13.

8. In a well or pocket for hydraulic separators, the combination of a shell or casing provided with a tangential water-inlet and with a vertical pipe or tube; vertical blades or wings at or near the top of said pipe to arrest the whirling motion of the water produced by the tangential arrangement of the inlet and to cause a vertical movement of the water at said point.

9. In combination with a trough, a supporting-collar 1; a tube 2 suspended from said collar; a flanged shell 3 carried by said tube; a casing 4 carried by said shell and provided with ledge 5 and wings 6; a plug 8 closing the lower end of the casing; a discharge-pipe 9; a tangentially-arranged inlet-pipe 10 communicating with the interior of the casing; non-radial inlet-openings 11 through the shell 3; a central core 12; and a spider 13 for said core provided with vertical wings or blades, all substantially as shown and described.

10. In combination with a trough, a supporting-collar 1; a tube 2 suspended from said collar; a flanged shell 3 carried by said tube; a casing 4 carried by said shell and provided with ledge 5 and wings 6; a plug 8 closing the lower end of the casing; a discharge-pipe 9; a tangentially-arranged inlet-pipe 10 communicating with the interior of the casing; non-radial inlet-openings 11 through the shell; and a spider 13 provided with vertical wings or blades, all substantially as shown and described.

11. In a well or pocket for hydraulic separators, the combination of an annular or cylindrical chamber provided with a tangential inlet for the admission of water; a vertical pipe or extension through which the water may rise; a tapering base to receive particles falling through the water; a non-radial passage for the delivery of water from the annular chamber to the upward extension; a central core; and blades or wings located above and below the annular or cylindrical chamber, and serving to arrest the whirling motion of the water which occurs between said points.

In witness whereof I hereunto set my hand in the presence of two witnesses.

ROBERT H. RICHARDS.

Witnesses:

JULIA WARD RICHARDS,

HENRY H. RICHARDS.