No. 840,354. PATENTED JAN. 1, 1907.

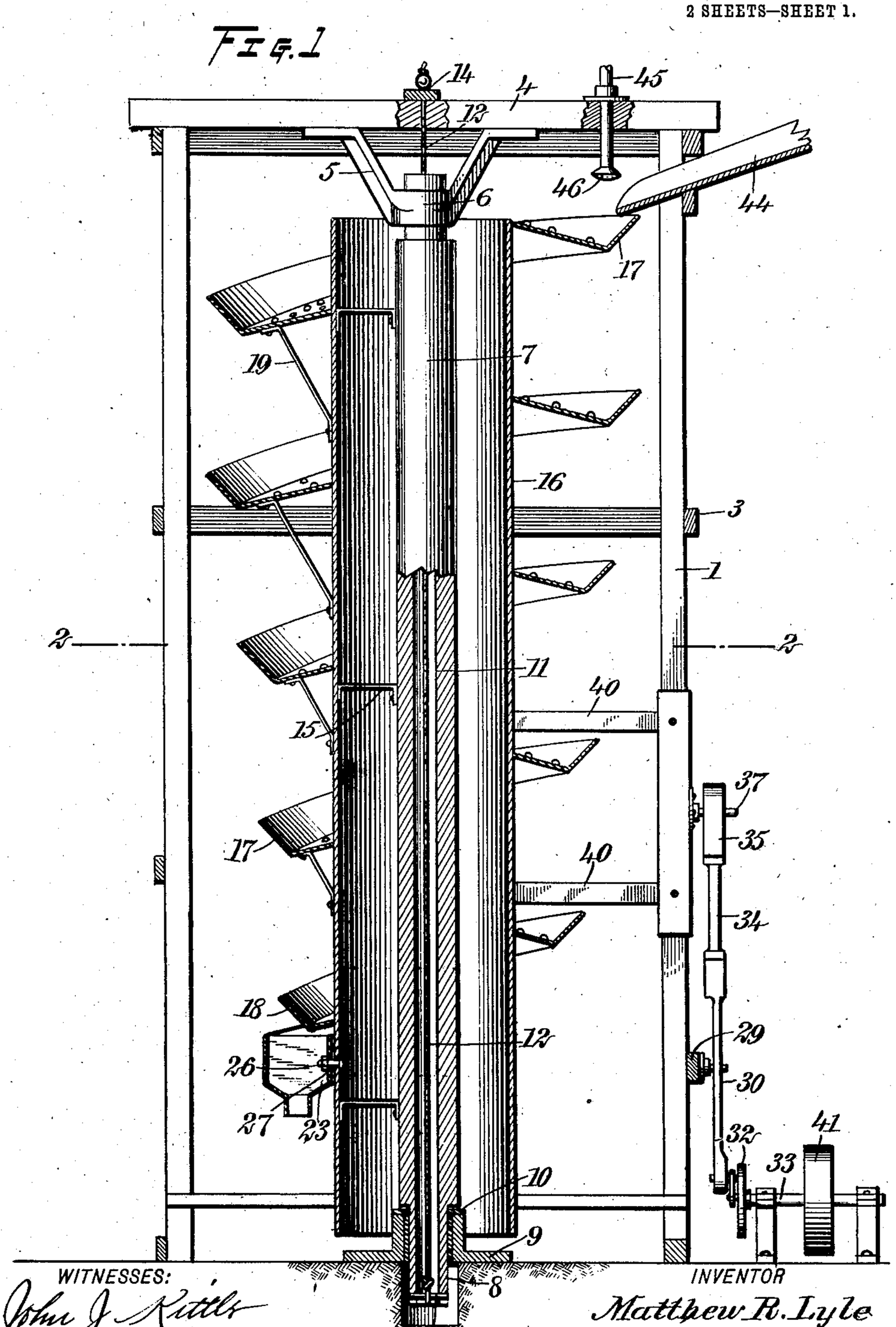
M. R. LYLE.

ORE SEPARATOR.

APPLICATION FILED NOV. 10, 1905.

2 SHEETS—SHEET 1.

FIG. 1



WITNESSES:

John J. Kittle

F. D. Dunman

INVENTOR

Matthew R. Lyle

BY Munn & Co

ATTORNEYS

No. 840,354. PATENTED JAN. 1, 1907.

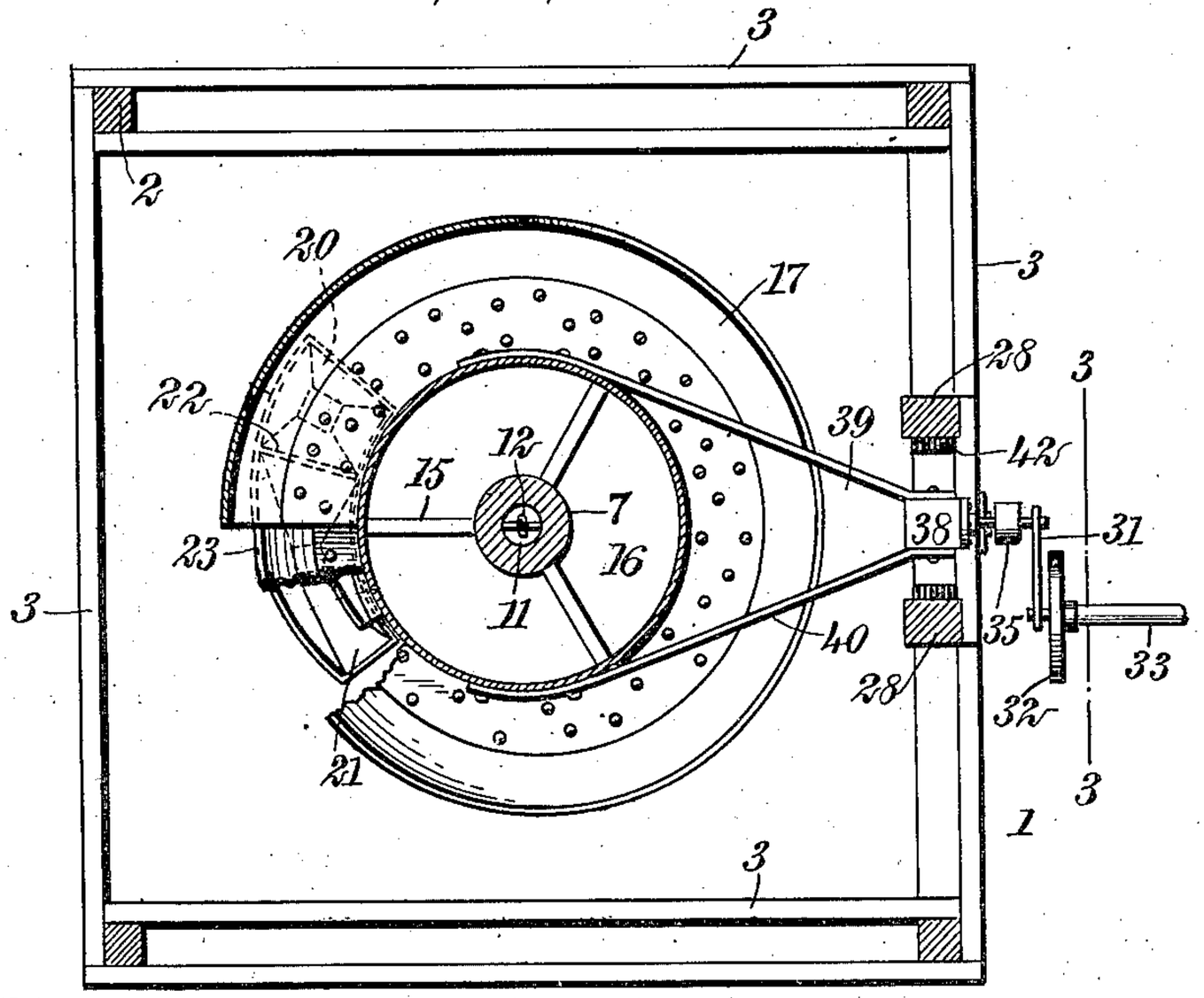
M. R. LYLE.

ORE SEPARATOR.

APPLICATION FILED NOV. 10, 1905.

2 SHEETS—SHEET 2.

Fig. 2



WITNESSES:

John J. Kitts

F. D. Crummer

INVENTOR

Matthew R. Lyle

BY

Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

MATTHEW ROBERT LYLE, OF OAKLAND, CALIFORNIA.

ORE-SEPARATOR.

No. 840,354. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed November 10, 1905. Serial No. 286,681.

To all whom it may concern:

Be it known that I, MATTHEW ROBERT LYLE, a citizen of the United States, and a resident of Oakland, in the county of Alameda and State of California, have invented a new and Improved Ore-Separator, of which the following is a full, clear, and exact description.

This invention relates to ore-separators, and it is especially adapted for effecting the separation of gold from its ore or from gold-bearing sand and gravel.

The invention relates especially to that class of separators which depend for their operation upon gravitation, the action of which is assisted by a constant agitation of the ore-bearing material.

The object of this invention is to provide an improved construction by means of which as the separation of the metal is effected the waste material will be constantly ejected.

Further objects of the invention are to provide means for reducing the forces to operate the device and to provide an arrangement which will prevent loss of metal in the waste sand.

The invention consists in the construction and combination of parts to be more fully described hereinafter, and definitely set forth in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a vertical cross-section through the machine, certain parts being shown in elevation and others being broken away. Fig. 2 is a horizontal cross-section on the line 2 2 of Fig. 1, certain parts being broken away. Fig. 3 is a side elevation, partly in section, on the line 3 3 of Fig. 2, showing a portion of the frame of the separator and illustrating especially the mechanism for agitating the same. Fig. 4 shows a portion of the lower extremity of the separator-body and chute, the upper portion of the said body being represented in cross-section together with portions of the chute; and Fig. 5 is a vertical cross-section showing a portion of the separator-body, together with portions of the chute, and illustrating a modified form which the chute may take.

Referring more particularly to the parts, 1 represents the frame substantially square in plan, the same comprising four corner posts or standards 2, connected by horizontal bars 3. This frame is maintained in an upright position, as shown, and across its upper end it supports a beam 4, to the under side of which a bracket 5 is rigidly attached. This bracket 5 is formed with a bearing 6, which receives the reduced upper extremity of a vertical shaft 7, said shaft being hollow, as shown, and provided at its lower extremity with a neck 8. This neck 8 passes through a bearing 9, preferably provided with a suitable bushing 10, as indicated. Through the bore 11 of the shaft 7 a cord or cable 12 passes and this cable has attached at its lower extremity a pin 13, which engages the lower extremity of the neck 8 in such a manner as to support the shaft in a vertical position. The upper extremity of this cable is supported at 14 on the beam 4.

By means of radial arms 15 a cylindrical shell or body 16 is rigidly attached to the shaft 7, as indicated. On the outer side of this body 16 the chute 17 is attached, the same being of helical form, as shown. This chute decreases in dimensions from its upper extremity downward so that at its lower extremity 18 it is of greatly-reduced dimensions, as indicated. It should be understood that this chute constitutes a continuous coil passing about the body 16. If desired, the individual coils may be made more rigid by means of suitable diagonal braces 19. At the lower extremity 18 of the chute I provide hoppers or receivers 20 21, which are preferably formed together, and separated by an edge or partition 22, as indicated most clearly in Fig. 2. These hoppers are preferably formed with circumferentially-disposed walls 23, which conform to the curvature of the body 16, the inner wall of the hoppers being disposed against the side of the body 16, as indicated most clearly in Fig. 1.

The hoppers are attached adjustably to the cylinder-wall by means of bolts 26, passing through circumferential slots. From this arrangement the hoppers may be adjusted with respect to the lower end of the chute 17.

I provide means for continuously agitating the separator-body and chute. For this purpose the frame 1 is preferably constructed with verticals or standards 28, two in number, and preferably disposed slightly apart, as shown. At a suitable point these verticals are connected by a bar 29, to which a rock-bar or rocker 30 is pivotally attached. The lower extremity of this rocker is connected by means of a connecting-rod or pitman 31

with a rotatable disk 32, rigidly mounted on a driving-shaft 33, which may be supported in any suitable manner. The upper extremity of the rocker 30 carries a longitudinally-disposed extension or whip 34, preferably formed of a resilient metal bar, such as steel. To the upper extremity of this whip or strap a head 35 is attached, the same having a longitudinal eye or slot 36. Into this slot 36 projects a pin 37, which is carried by a block 38, the said block being rigidly attached to the extremity of an arm 39. (Shown most clearly in Fig. 2.) This arm preferably comprises oppositely-disposed inclined members 40, which are rigidly attached on opposite sides of the body 16, as shown.

The shaft 33 carries rigidly a belt-pulley 41, which is adapted to be continuously driven when the device is in operation. By this means the rocker 30 is reciprocated, and through the medium of the arm 39 the separator-body 16 is reciprocated in a rotary manner. I provide buffers or pads 42, and these are attached on the adjacent faces of the uprights 28 and in the path of the moving block 38. From this arrangement the lateral movements of the arm are arrested and a sudden jolt or jar imparted to the material in the chute at the end of each throw.

I may make the cross-section of the chute 17 in the form shown in Fig. 1; but the number of coils or pitch of the helix may be changed, as desired. For instance, it may be of high pitch, having a great number of coils, as shown in Fig. 4. Instead of making the chute of the form shown in Figs. 1 and 4, I may make the bottom rounded or corrugated or I may give the chute a rectangular form, such as shown in Fig. 5, where the bottom 43 is substantially horizontal, or any other desired form or cross-section of chute may be used.

In Fig. 4 the hoppers 20 and 21 are represented in position just below the lower extremity of the chute. These hoppers may be adjusted as intimated above, so as to change their angular relation with respect to the end of the chute. The purpose of this adjustment will be described more fully hereinafter.

The crushed ore or gold-bearing sand or gravel will be introduced to the upper extremity of the chute by means of a suitable feed-trough 44, and at a suitable point at the upper end of the chute a vertical pipe 45 is provided which affords means for delivering water to the upper end of the chute through a suitable nozzle 46. The separating process may be carried on dry—that is, without the addition of any water. It may also be carried on with the body and chute constructed substantially as described above, the same being arranged within a vessel containing water. In this latter case the water will not be agitated in any way, but will serve to release what values may be contained in particles of dirt and assist the heavy values in finding their way to the bottom of the trough or chute through the gravel, besides carrying off the loose dirt which it may take up in mechanical suspension. Instead of immersing the entire device in water, as suggested, I may use a stream of water delivered to the upper portion of the chute through the nozzle 46, which would assist in washing down the ore and separating the gold from the waste.

The mechanical process of effecting the separation is much the same whether the device be operated with or without water as an aid to the separation. The gold-bearing sand, gravel, or crushed ore will be fed to the upper portion of the chute, and the separator-body 16, together with the chute, will be reciprocated in a rotary manner. In this way the material gravitates slowly toward the lower portion of the chute, and by reason of the greater specific gravity of the gold the metal exerts a tendency to find its way toward the bottom of the trough. As the cross-section or volume of the trough diminishes gradually toward its lower extremity the upper layers of the material will be constantly thrown off as the operation progresses, and eventually the values having settled onto the floor of the chute and into the bottom of the trough arrive at the lower end 18 of the chute, at which point they pass into the hopper 21. In order to prevent any possibility of gold-bearing material being lost by ejection above the hopper 21, I provide the extra hopper 20, described above. This hopper is of course separated from the hopper 21, and the material which it captures will be re-treated in the separator.

The manner of adjusting the hoppers 20 21 is as follows: In case the sand is very rich or for other reasons if a complete separation is not effected before reaching the hopper 21 then the hoppers will be adjusted, as far as possible, so as to catch a larger quantity of the material falling over the edge of the chute near the lower end. If, on the other hand, the separation is very complete, the hoppers will be adjusted to a more extreme position beyond the end 18 of the chute and so as to reduce the quantity of tailings which will be caught in the hopper 20. This adjustment is of course in a horizontal direction and is effected by means of the bolts 26, working in the slots 27.

I regard the feature of the process which consists in ejecting continually the waste sand as highly advantageous, as it relieves the richer portions of the sand beneath from pressure. In this way as the weight upon the richer sand is reduced it does not pack itself tightly, but remains in a loose mass, as will be readily understood, and this condition is highly conducive to effect a thorough

separation of the values from the waste. Attention is called to the fact that none of the weight of the separator-body 16 and the chute 17 is taken upon the bearings 6 and 9. These bearings simply maintain the separator in a vertical position. Its weight is entirely supported by the cord or cable 12. From this arrangement the frictional losses are very slight, and the forces necessary to effect the reciprocation of the separator-body become insignificant.

When I am working the separator with a stream of water running in the chute, the incline of the chute should be very much less than that used when the device is operating as a dry separator. Special attention is again called to the tapering construction of the chute, which results in continuously ejecting the waste sand in the upper portion of the chute, which assists in concentrating the values in the lower part.

While I have described a certain frame construction in connection with the separator, obviously I may use the separator-body, supported in any suitable manner, in a vertical position, and the chute could be disposed as well inside the body of the cylinder as outside.

Also, while I have described the body of the separator as a cylinder, any suitable structure may be used to carry the chute and hold it in position, such as a center shaft, as shown, having brackets or arms extending from the shaft and carrying the coils, but having no cylinder or casing.

In practice I may make the chute a simple helix, as illustrated, or I may make the chute in the form of an inverted spiral, the coils decreasing in diameter toward the bottom.

The surface of the chute 17 may be roughened either by elevations or depressions, or both, to cause friction to assist in agitating the gravel as it passes over.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A separator having a chute diminishing in sectional area toward one extremity thereof, and means for agitating said chute, said chute presenting an overhanging edge throughout the length thereof, whereby the waste material is constantly ejected from said separator as it progresses downwardly.

2. A separator having a helically-disposed chute tapering toward its lower extremity whereby the upper layers of the material moving down are constantly ejected from said separator, and means for giving said chute a reciprocating rotary movement.

3. A separator having a substantially round body and a chute attached thereto and disposed in helical coils thereabout, the edges of the uppermost of said coils projecting beyond the coils therebelow, and means for giving said chute a reciprocating rotary movement, to eject the material from said separator throughout the entire length of said chute.

4. A separator having a substantially cylindrical body with a chute attached thereto and tapering toward the lower extremity thereof, said chute being arranged so that the material falling over the edge thereof is ejected from said separator, and means for imparting a reciprocating rotary movement to the said body.

5. In a separator, in combination, a body carrying a chute in which a separation may be effected, a cord supporting said body, and means for imparting a reciprocating rotary movement to said body.

6. In a separator, in combination, a frame, a body carrying a chute, a cord supporting said body, members engaging the extremities of said body and maintaining the same in a substantially upright position, and means for imparting a reciprocating rotary movement to said body.

7. In a separator, in combination, a frame presenting a beam, a hanger disposed below said beam, a hollow body disposed beneath said hanger, a cord suspending said body from said beam, said body engaging said hanger and maintaining the same in a vertical position, and means for imparting a reciprocating movement to said body.

8. In an ore-separator, in combination, a substantially cylindrical body, a chute disposed in coils thereabout decreasing in dimension toward the lower end of said body, and a pair of hoppers attached to said body at the lower end of said chute and adapted respectively to receive the material from the end of said chute and the waste overflow adjacent to the same, and means for adjusting said hoppers in a substantially horizontal plane beneath the lower end of said chute.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MATTHEW ROBERT LYLE.

Witnesses:

JAMES P. HARRIS,

CLARENCE M. REED.