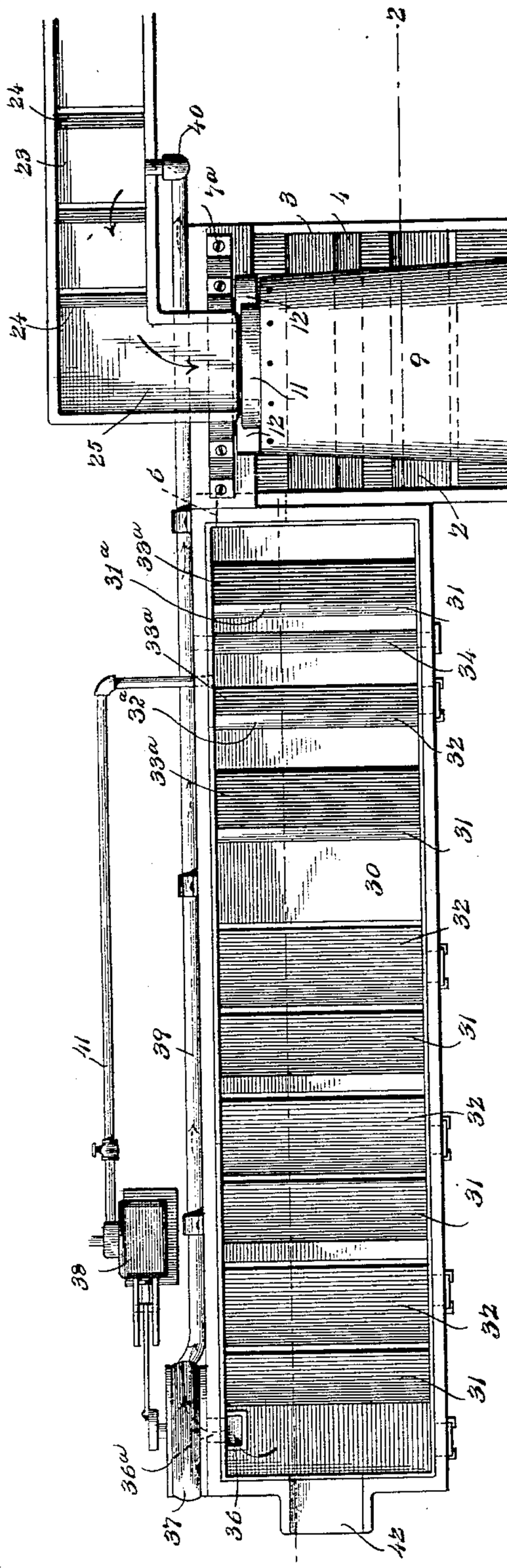
No. 633,445. Patented Sept. 19, 1899.

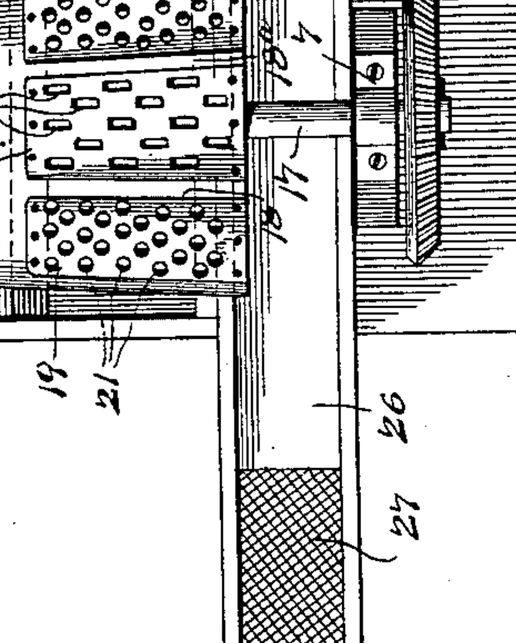
H. FULLER.

ORE SEPARATOR AND AMALGAMATOR.

(Application filed Dec. 23, 1897.)

(No Model.) 3 Sheets—Sheet 1.





Witnesses
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(No Model.) 3 Sheets—Sheet 2.

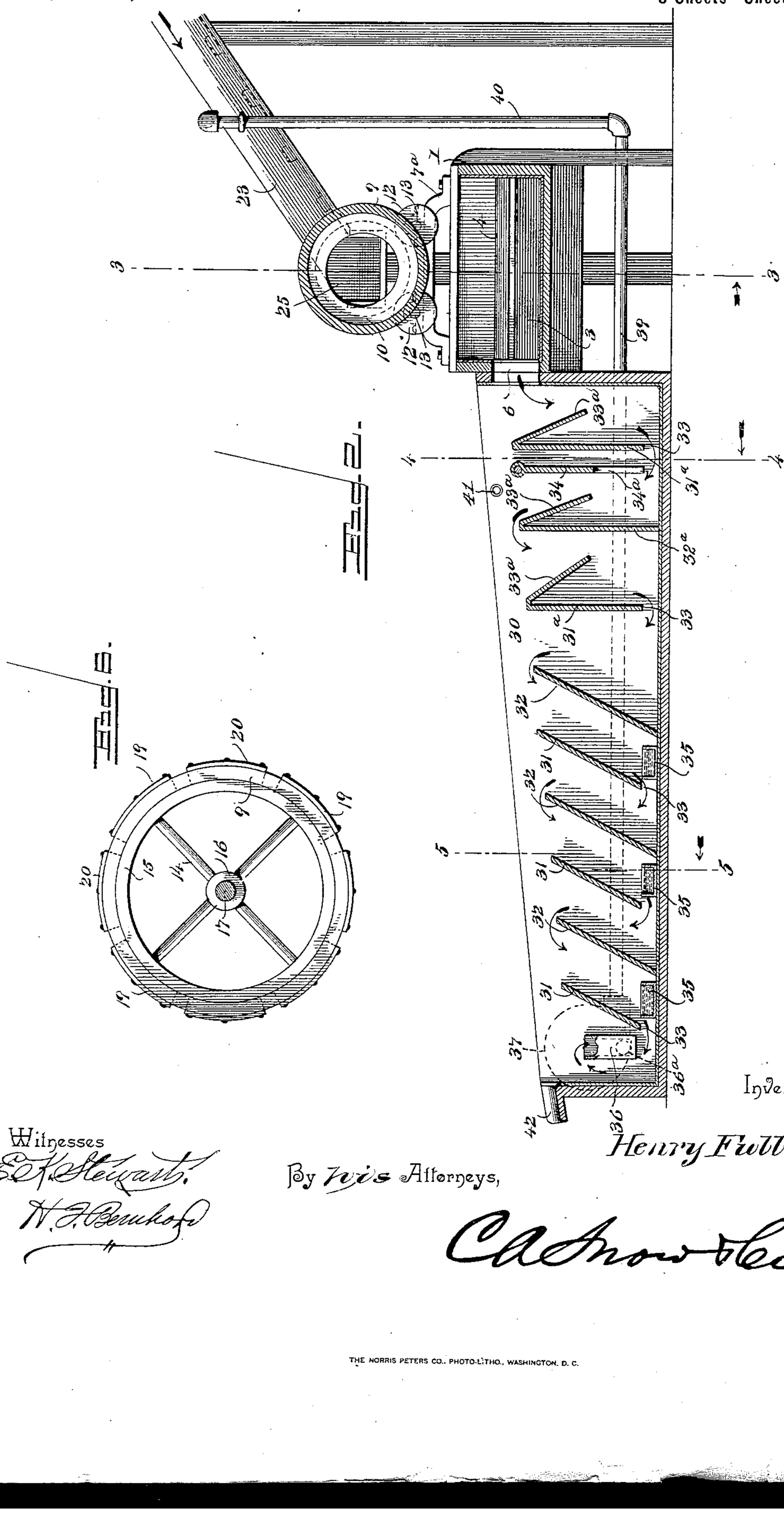

FIG. 2.

FIG. 5.

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ORE SEPARATOR AND AMALGAMATOR.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

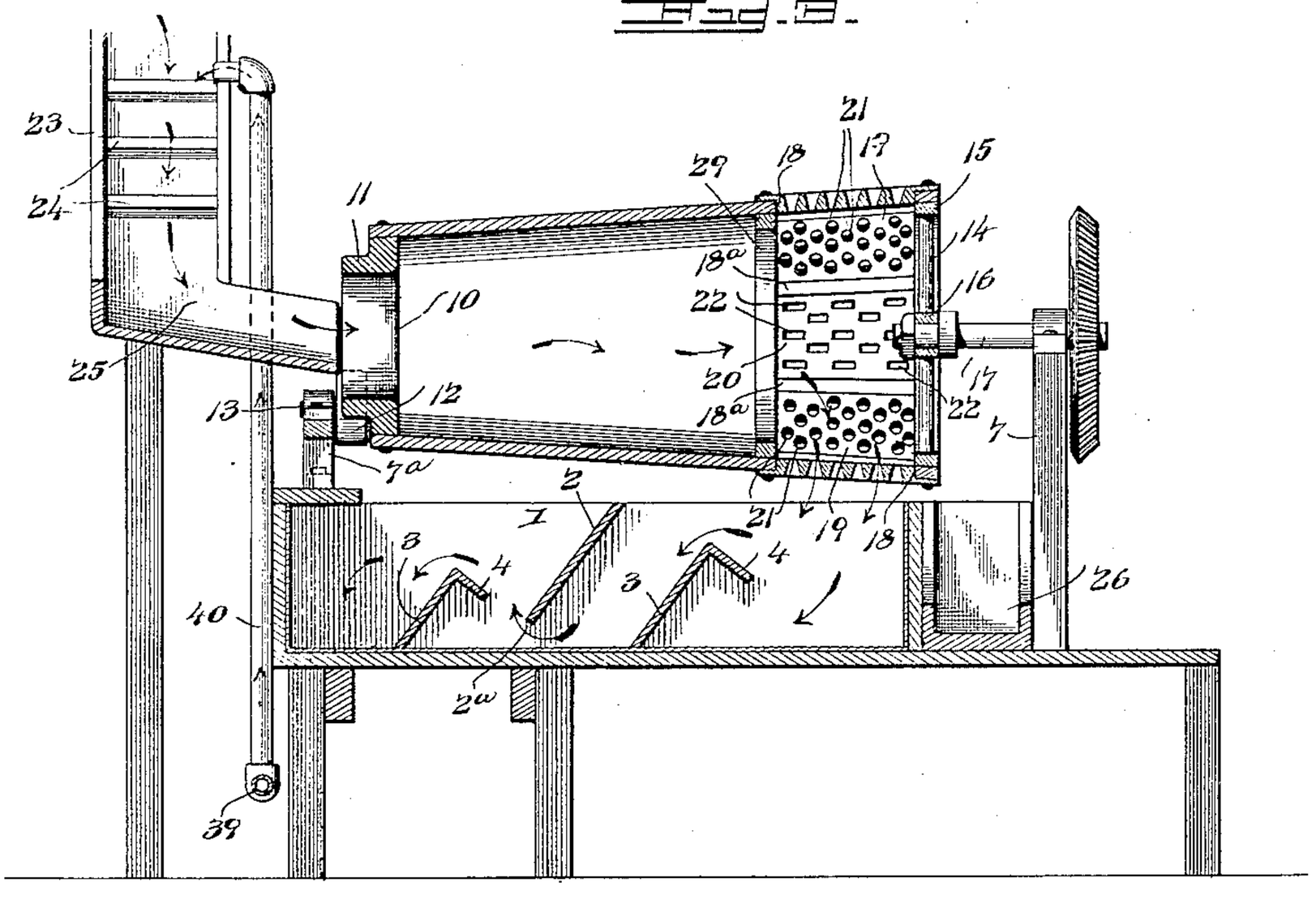


Fig. 4.

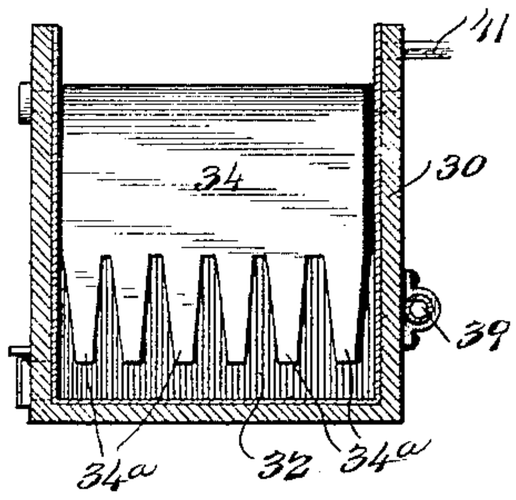
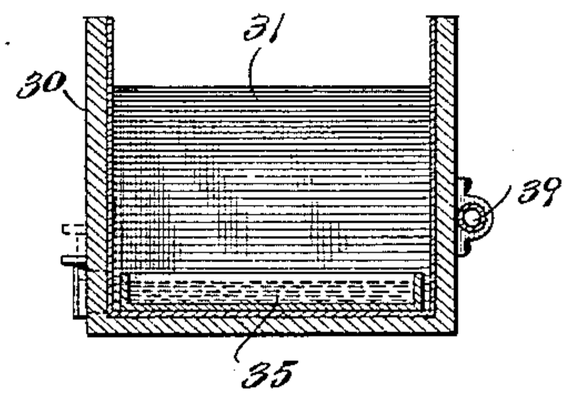


Fig. 5.



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UNITED STATES PATENT OFFICE.

HENRY FULLER, OF CHICAGO, ILLINOIS.

ORE SEPARATOR AND AMALGAMATOR.

SPECIFICATION forming part of Letters Patent No. 633,445, dated September 19, 1899.

Application filed December 23, 1897. Serial No. 663,219. (No model.)

To all whom it may concern:

Be it known that I, HENRY FULLER, a citizen of the United States, residing at Chicago, (Englewood,) in the county of Cook and State of Illinois, have invented a new and useful Ore Separator and Amalgamator, of which the following is a specification.

My invention relates to improvements in ore separators and amalgamators; and among other things the objects that I have in view are to provide an apparatus in which the metallic particles of precious metal are mechanically separated or screened from the gravel, dirt, and other refuse at an early stage of the treatment of the ore; to collect the precious metals as the liquid pursues its course through the settling-chamber; to utilize the liquid continuously in the treatment of the ore and reduce waste of the liquid to a minimum, thus rendering the apparatus especially serviceable in localities where water is scarce; to provide for ready access to all of the working parts of the apparatus, and to simplify the construction and render it durable and efficient in service.

With these ends in view my invention consists in the novel combination of elements and in the construction and arrangement of parts, which will be hereinafter fully described and claimed.

To enable others to understand the invention, I have illustrated the same in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a plan view of an ore separator and amalgamator constructed in accordance with my invention. Fig. 2 is a vertical longitudinal sectional view through the settling-chamber, the revoluble cylinder, and the sluiceway on the irregular plane indicated by the dotted line 2 2 of Fig. 1. Fig. 3 is a vertical sectional elevation taken longitudinally through the revoluble cylinder and the primary sluiceway on the plane indicated by the dotted line 3 3 of Fig. 2, looking in the direction indicated by the arrow. Fig. 4 is a vertical sectional elevation taken transversely through the settling-chamber on the plane indicated by the dotted line 4 4 of Fig. 2, looking toward the magnetic collecting-plate. Fig. 5 is a vertical transverse section through the settling-chamber on the plane indicated by the dotted line 5 5 of Fig. 2. Fig. 6 is a detail view in elevation of the delivery end of the revoluble cylinder, showing the construction of the spider thereof. Fig. 7 is a detail longitudinal sectional view through the refuse-discharge chute, illustrating the screen and the collecting-compartment thereof.

Like numerals of reference denote like and corresponding parts in each of the several figures of the drawings.

1 designates the primary sluiceway, which is erected in a horizontal position and at a suitable elevation above the settling-chamber, presently described. This primary sluiceway is arranged substantially at right angles to the settling-chamber, and within said primary sluiceway is provided a series of inclined partitions 2 3. By reference to Fig. 3 of the drawings it will be seen that I have illustrated the sluiceway as equipped with three partitions; but the number of these partitions is not material, and they may be increased or decreased according to the length of the sluiceway. The partition 2 is situated between the partitions 3, and said partition 2 extends from the upper open edge of the sluiceway to a suitable distance above and out of contact with the bottom of said sluiceway, thus forming an opening 2^a between the lower edge of said partition 2 and the sluiceway-bottom. The partitions 3 are situated on opposite sides of said partition 2, and they extend from the sluiceway-bottom to a suitable distance below the upper open end of said sluiceway to provide for the passage of liquid and ore over the upper edges of the partitions 3, said partitions having suitably-inclined baffles 4, which tend to break the force of the current of water flowing thereover. The described construction and arrangement of the partitions provides a tortuous channel or course through the sluiceway for the passage of the water and ore, and the baffles on the partitions 3 also serve the purpose of preventing the dirt and other refuse from passing freely with the water into the settling-chamber. The sluiceway is arranged to receive at its head the ore and water from an overhead cylinder 9, and at its opposite end the sluiceway is provided with a discharge-port 6, (see Fig. 2,) by which the water and ore are allowed to flow into the set-

tling-chamber 30, said discharge-port 6 being formed in one of the walls of the sluiceway, at or near the bottom thereof, to provide for the free and ready passage of the water and ore into said settling-chamber.

On the framework which supports the sluiceway 1 are erected the standards 7 7ª, which serve to support the revoluble cylinder 9 in operative and compact relation to the sluiceway 1. This revoluble cylinder is arranged over the sluiceway longitudinally with respect thereto and close down toward the latter, thus disposing the parts in compact relation, and into this revoluble cylinder is delivered the ore mixed with dirt, gravel, and sand. The function of the revoluble cylinder is to separate the metallic particles of ore from the refuse—such as sand, gravel, and dirt—at the initial stage in the treatment of the ore, and said cylinder is so constructed and arranged as to discharge the washings and ore into the head of the sluiceway, while the refuse, such as gravel and dirt, are discharged through the lower end of the cylinder onto a refuse-chute 26.

The revoluble cylinder of my improved separator and amalgamator is supported by novel devices over the sluiceway, and at one end of this cylinder an annular bearing-ring 10 is rigidly secured, said ring being open and exposed for the introduction of the ore and water into the cylinder from the feed chute or flume 23. This bearing-ring 10 is provided with an annular flange 11, arranged to project beyond the ring itself and the small end of the cone-shaped cylinder 9, and said flange of the bearing-ring rests upon the idler-rollers 12, which are mounted on shafts 13, supported in the standard 7ª at one end of the sluiceway. These supporting idler-rollers 12 are arranged on opposite sides of the vertical axis of the revoluble cylinder 9, and the small receiving end of said cylinder is thus rotatably supported or mounted to enable the cylinder to turn freely on its longitudinal axis with a minimum amount of friction between the parts in contact with each other. At the other end of the revoluble cone-shaped cylinder 9 I provide a spider 14. (See Figs. 3 and 6). This spider is integral with a large ring 15 and a central bearing 16, and the ring 15 is secured rigidly to the large end of the revoluble cylinder 9 in any suitable way.

By reference to Figs. 2 and 3 of the drawings it will be seen that I construct the revoluble cylinder of tapering or conical form and that the ore is supplied to the small end of the cylinder, so that it it is free to pass or flow through the cylinder by gravity, the travel of the ore being facilitated by rotary motion imparted to the cylinder through the medium of a shaft 17. This shaft 17 serves two purposes—first, as the means for rotating the cylinder, and, secondly, as the means for supporting the large delivery end of the cylinder over the head of the sluiceway 1. This shaft is arranged in a horizontal position in axial relation to the cylinder, and its inner end is united rigidly in a suitable way to the bearing 16 of the spider 14. Said shaft is journaled in a bearing or bearings provided on the upper end of the standard 7, erected beyond the head of the sluiceway, and this shaft carries a suitable power-applying mechanism, with which is operatively connected a part of a power-transmitting mechanism for the purpose of rotating the shaft and the cylinder to which it is rigidly connected. As shown by Figs. 1 and 3 of the drawings, the power-shaft 17 is equipped with a miter-gear, with which meshes a miter-gear pinion on a short shaft carrying a belt-pulley; but the described mechanism for rotating the shaft 17 is not material, and the same may be varied within the province of a skilled mechanic.

From the foregoing description, taken in connection with the drawings, it will be seen that I have provided a longitudinally-tapered revoluble cylinder which is supported at one end on idler bearing-rollers and which has its other end fastened rigidly to a shaft that supports the cylinder in its proper relation to the sluiceway and also serves as the means for rotating the cylinder on its longitudinal axis, and in this connection it is to be observed that the spider 14, which serves to couple one end of the power-shaft rigidly to the discharge end of said revoluble cylinder, does not at all interfere with the free discharge of the refuse sand, gravel, and dirt from the large end of the cylinder, because the arms of the cylinder are spaced apart, as shown by Fig. 6, to enable such refuse to pass freely through the large end of said revoluble cylinder 9.

The cylinder is provided near its delivery end with a series of perforated and slotted screen-plates, as shown by Figs. 1 and 3, arranged to deliver the ore and liquid to the head of the sluiceway 1. Within the open delivery end of the cylinder it is cut away at intervals to provide a series of longitudinal bars 18ª, which are spaced in parallel relation to each other, so as to provide a series of intervening openings or slots 18. These slots or openings are covered by the screen-plates 19 20, which are secured firmly to the bars 18ª. The screen-plates 19, of which a series are provided, have circular holes or apertures 21; but the screen-plates 20 are provided with oblong slots 22. (See Fig. 3.) The screen-plates 19, with the circular holes therein, are in alternate relation to the screen-plates 20, having the oblong slots, and these series of screen-plates extend entirely around the slotted end of the cylinder adjacent to the delivery-opening therein. Within the cylinder is arranged a detaining rib or ring 29, which is situated adjacent to the ends of the screen-plates 19 20, toward the feed chute or flume 23, and this detaining-rib 29 serves to prevent the nuggets or other large particles of gold from passing through the open delivery end of said cylinder into the refuse-chute.

The openings or slots in the screen-plates preferably flare from the inside toward the outside of the cylinder, thus providing for the free and rapid passage of the water and ore through the screen-plates into the head of the sluiceway 1.

The ore and water are fed to the revoluble tapering cylinder 9 through the flume 23, arranged in an inclined position adjacent to the small receiving end of said cylinder, and this flume is provided with a laterally-extending delivery-mouth 25, which projects more or less into the bearing-ring 10 at the receiving end of the cylinder. This flume is provided at intervals throughout its length with a series of riffles 24, which serve to check the rapid flow of water and ore over the chute or flume into the revoluble cylinder.

Beneath the large delivery end of the revoluble cylinder is a refuse-discharge chute 26, arranged in an inclined position to project a suitable distance beyond the side of the sluiceway 1, adjacent to the settling-chamber 30. This refuse-discharge chute is arranged to receive directly from the large delivery end of said cylinder, and the gravel, sand, and dirt deposited therein are discharged from said chute by gravity. To collect any particles of ore which may escape with the refuse through the delivery end of the cylinder, I provide this refuse-chute with an elongated longitudinal screen 27, suitably fastened therein in the plane of the bottom of said chute, and below this screen the chute 26 is provided with a collecting-compartment 28, into which any escaping particles of ore may lodge and be collected for subsequent removal from said compartment. It is of course understood that the metallic particles of ore are heavier than the sand, dirt, and gravel constituting the refuse deposited from the cylinder into the chute 26, and as the refuse and ore travel over and along the chute the metallic particles of ore have a tendency to work their way beyond the bottom of said chute. Hence the metallic particles of ore are adapted to pass through the screen 27 into the collecting-compartment 28.

The settling-chamber 30 of my improved apparatus extends at right angles to the sluiceway 1, and it is of suitable length to retain within itself the washings and ore for quite a period of time, thereby preventing the rapid flow of water therefrom and enabling the metallic particles of ore to be collected by the amalgamated plates and the amalgam receptacles within said settling-chamber. The settling-chamber is equipped with devices which serve to force the water and ore into a tortuous course or channel not only to tranquilize the flow of the water therethrough, but to effect the collection of the metallic particles of ore before the water is allowed to escape from the settling-chamber, and in the preferred embodiment of this part of my invention I employ the collecting-plates 31 32 and the amalgam-receptacles 35, arranged substantially as shown by Figs. 1, 2, 4, and 5 of the drawings.

The settling-chamber 30 has its receiving end situated adjacent to the delivery end of the sluiceway 1 for the purpose of receiving the ore and liquid through the ports 6 in said sluiceway. (See Fig. 2). The plates 31 32 are arranged in vertically-inclined positions within the settling-chamber and in alternate relation to each other, and each plate of the series of plates has both surfaces thereof coated or provided with a suitable amalgam, such as mercury, for the purpose of causing the said plates to collect the metallic particles of ore held in suspension in the water discharged from the sluiceway into the settling-chamber.

The plates 31, constituting one series of plates, are fixed within the settling-chamber in any suitable way to have their upper edges terminate at a suitable distance below the upper open side of said settling-chamber, while the lower edges of said plates 31 terminate a suitable distance above the bottom of the settling-chamber to form the openings 33 between said plates 31 and the bottom of said settling-chamber. The other plates 32, constituting another series within the settling-chamber, are arranged in alternate relation to the plates 31, and each plate 32 extends from and joins with the bottom of the settling-chamber to prevent the flow or passage of water and ore beneath its lower edge, thus causing the water and ore to pass over the upper edges of the plates 32, as shown by the arrows in Fig. 2. It will thus be seen that the plates 31 cause the water to pass through the openings 33 beneath the said plates, while the plates 32 force the water to flow over their upper edges, thereby causing the water to flow in a tortuous course or channel through the settling-chamber, preventing the rapid flow thereof and insuring tranquillity to the movement of the water and ore. By reference to Fig. 2 it will be observed that certain plates 31^a 32^a, adjacent to the ports 6 from the sluiceway 1, have the inclined baffles 33^a. The plates 31^a 32^a, provided with these inclined baffles, are secured in vertical positions within the settling-chamber; but the remaining plates 31 32 within the settling-chamber are inclined vertically therein to better present their amalgamated surfaces to the ore as it passes, with the water, through the chamber.

The inclination of the collecting-plates within the settling-chamber and the employment of the inclined baffles on certain vertically-disposed collecting-plates at the head of said settling-chamber are important features in the construction of my settling-chamber, because the collecting-plates not only tranquilize the flow of water through the chamber, but their inclined amalgamated surfaces operate efficiently to catch and retain the ore in suspension in the liquid.

The amalgam boxes or receptacles 35 are

placed on the bottom of the settling-chamber between each pair of adjacent partitions 31 32 therein, and, as will be observed by reference to Fig. 2, one of the amalgam boxes or receptacles is positioned adjacent to and in advance or on the inlet side of each of the openings 33 beneath each plate 31, so that the liquid as it flows over the plate 32 and under the lower edge of the plate 31 is caused to traverse or sweep close to the amalgam receptacles or boxes, whereby the metallic particles of ore are deposited in and collected by the mercury contained within said amalgam-receptacles.

In the treatment of certain kinds of ore it is found that the ore contains a small percentage of metallic particles of iron and other magnetizable substances, which it is desirable to eliminate from the precious metal contained in the ore, and to effect this end I employ magnetic devices in the settling-chamber to attract and retain the particles of iron ore and other magnetizable substances. In the preferred embodiment of this part of my invention I provide a magnetic collecting-plate 34, which may consist of a sheet-iron plate permanently magnetized in any suitable way. This magnetic collecting-plate 34 is provided at its lower end with a series of incisions, forming a series of fingers 34ª, and said magnetic plate 34 is suspended in the settling-chamber in a suitable way at the head thereof and between two of the amalgamated collecting plates or partitions 31 32. By reference to Figs. 2 and 4 it will be seen that the magnetic collecting-plate is suspended at the head end of the collecting-chamber to have the fingers 34ª terminate above the bottom of the settling-chamber and thus provide for the free passage of ore and water from the opening 33 beneath one amalgamated plate 31 to the adjacent amalgamated plate 32, and the incisions or slots formed between the fingers 34ª of said magnetic plate 34 provide for the free and uninterrupted flow of water and ore from one collecting-plate to the other within the settling-chamber. The magnetic plate 34 is thus arranged within the settling-chamber to collect the particles of iron or other magnetizable substance immediately on the deposit of the liquid and ore into the settling-chamber.

As will be seen by reference to Figs. 2 and 4, the magnetic plate 34 is arranged between and in coöperative relation to a pair of amalgamated plates, and thus the current bearing the ore is adapted to sweep below the magnetic plate after passing the first amalgamated plate 31ª, and thence travel up the rear side of the magnetic plate before it flows through the second amalgamated plate 32ª. By forming the lower edge of the magnetic plate with a series of slots the fingers 34ª of the magnetic plate are made to serve the purposes of pole-pieces for the collection of magnetizable substances. As the plate 34 is rendered permanently magnetic in any appropriate manner and as the pole-pieces thereof are interposed in the path of the current as it sweeps below one amalgamated plate and over the next amalgamated plate, the pole-pieces or fingers will attract and retain any magnetizable substances which may be brought by the current within the range of the magnetic field of said fingers or pole-pieces.

At the discharge end of the settling-chamber I provide a water-delivery spout 36, which is attached to one of the side walls of said settling-chamber to inclose the water-exit port or opening 36ª. (Indicated by dotted lines in Fig. 2.) The lower end of this water-delivery spout 36 is closed before the upper end thereof is opened for the free ingress of water into the spout and thence to the exit-opening 36ª.

I prefer to construct my apparatus with means for returning the water which passes through the settling-chamber back to the flume or feed-chute 23 for the purpose of utilizing the water continuously in the washing and treatment of the ore and to effect economy in the consumption of water whereby the apparatus is rendered especially available for use in localities having a limited water-supply. To these ends I employ a return-pipe 39, which is arranged in compact relation to the settling-chamber and the flume 23, as shown by Fig. 2. This return-pipe is operatively connected with a pump 37, having its source of liquid-supply connected with the water-exit port 36ª from the settling-chamber, and this pump 37 is driven by an engine, (indicated in a general way at 38 in the drawings.) I have shown this return-pump as one of that class known to those skilled in the art as "rotary" pumps; but it will be understood that I do not desire to strictly confine myself to this precise form of pump for mechanically forcing the water from the settling-chamber through the return-pipe 39 to the flume 23. This return-pipe 39 has a vertically-extending branch 40, which terminates in a discharge-mouth extending over the flume or feed-chute 23, as shown by Figs. 1 and 2. In case the pump and return-pipe should get out of order, so that the water could not be pumped back from the settling-chamber into the flume, the water from the settling-chamber is allowed to escape through an overflow-spout 42, provided on the discharge end of the settling-chamber and on a plane above the open end of the delivery-spout 36; but under normal conditions the water from the settling-chamber is allowed to pass into the delivery-spout 36 before it passes to and through the overflow-spout 42, so that the water may be mechanically forced by the action of the rotary pump through the pipe 39 back to the flume 23. The engine 38 may be of any suitable type, and with said engine is or may be combined the power-transmitting appliance or appliances for rotating the shaft 17 to drive the revoluble cylinder 9.

Under some conditions of service of the apparatus—as, for instance, when washing and

separating ore during the winter season of the year—the water as it flows through the settling-chamber might have a tendency to freeze, and thereby prevent the free flow of water through the apparatus; but to overcome this objection I provide means for heating the water in the settling-chamber. In the simplest form of my invention the heating appliance for the water in the settling-chamber consists of a steam-pipe 41, which is connected with the exhaust from the engine 38 and has one end or branch thereof connected to the settling-chamber 30 at or near the head thereof, whereby the exhaust-steam from the engine may be delivered into the settling-chamber for the purpose described. As shown, this exhaust-steam pipe 41 is equipped with a suitable valve 44, which may be closed to cut off the flow of steam therethrough.

The operation may be described briefly as follows: The ore, mixed with sand, gravel, and the proper quantity of water, flows through the feed-chute or flume 23 and its delivery-mouth 25 into the small receiving end of the tapering cylinder 9. As the cylinder rotates the ore and water flow therethrough, the gravel and other refuse pass over the screen-plates 19 20 into the refuse-chute 26, while the ore and water pass through the openings and slots in said screen-plates into the head of the sluiceway 1. Any large particles or nuggets of precious metal in the ore are caught and retained by the annular rib or ring 29 within the revoluble cylinder, and these particles or nuggets may be subsequently removed by hand or in any other suitable manner from said cylinder 9. The water and ore flow over the partitions and baffles 2 3 within the sluiceway and find their exit through the ports 6 into the head of the settling-chamber. The partitions or plates within the settling-chamber cause the liquid and ore to travel in a circuitous course through said chamber, and the ore is collected by the amalgamated surfaces of the partitions or plates and by the mercury in the amalgam-receptacles 35. The ore passes through the delivery-spout 36 to the return-pump 37, which forces the water through the pipe 39 back to the flume, thus allowing the water to be used continuously, and as the ore passes through the settling-chamber the metallic particles of iron and other magnetic substances are attracted by and retained on the permanently-magnetic plate 34.

It is evident that slight changes in the form and proportion of parts and in the details of construction may be made without departing from the spirit or sacrificing the advantages of the invention, and I therefore reserve the right to make such changes in the form and proportion of parts as fairly fall within the scope of this invention.

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

1. In an ore separator and amalgamator, the combination with a settling-chamber, of a series of amalgamated plates arranged therein to form a tortuous channel for the circulation of water and ore, and a permanently-magnetic collecting-plate suspended between adjacent amalgamated plates and provided at its lower edge with a series of fingers which permit of the circulation of liquid and ore, substantially as described.

2. In an ore separator and amalgamator, a settling-chamber provided with two series of amalgamated plates arranged to form a tortuous passage for the flow of ore-washings, other amalgamated plates provided with offstanding baffles and situated in the settling-chamber at the head or receiving end thereof, and a magnetic plate suspended in the chamber between adjacent plates having the baffles, whereby the flow of ore-washings is tranquilized, the fine floating metal is free to amalgamate with the plates, and magnetizable metals are attracted by the magnetic plate, substantially as described.

3. In an ore separator and amalgamator, spaced amalgamated plates disposed in the path of the water and ore, and serving to deflect the same in transit, and a magnetic plate arranged between the spaced plates in the path of the deflected ore and water and having spaced portions, substantially as described.

4. In an ore separator and amalgamator, spaced amalgamated plates vertically arranged in the path of the ore and water, and adapted to deflect the same in transit, baffle-plates joined at their upper edges to the upper portions of the spaced amalgamated plates and inclining forwardly and downwardly, a magnetic plate disposed between the spaced amalgamated plates and in the path of the deflected ore and water and having spaced portions, substantially as described.

5. In an ore separator and amalgamator, the combination of an elevated revoluble cylinder having a discharge at one end, a horizontal sluiceway below and longitudinally of the cylinder to receive ore-washings at its head, the baffles, 3, fixed within the sluiceway below the head thereof and provided with the offstanding lips, 4, at their upper edges, the intermediate baffle, 2, also fixed within the sluiceway and arranged to form with the baffles, 3, the tortuous passage through the sluiceway for tranquilizing the flow of ore-washings, and a settling-chamber having amalgamated collector devices, substantially as described.

6. In an ore separator and amalgamator, the combination of a settling-chamber provided with a plurality of amalgamated plates arranged to form a tortuous passage within said chamber for tranquilizing the flow of ore-washings therethrough, an overflow-spout, 42, at the discharge end of said chamber, a return water-pipe connected to the settling-chamber at its discharge end and near the

bottom thereof, an outlet-pipe, 36, over the end of the return water-pipe and having its upper end terminating in the settling-chamber on a plane between the overflow-spout and the open receiving end of the return water-pipe, and a pump, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

HENRY FULLER.

Witnesses:

SARAH E. FULLER,

JOHN M. CAMELON.