

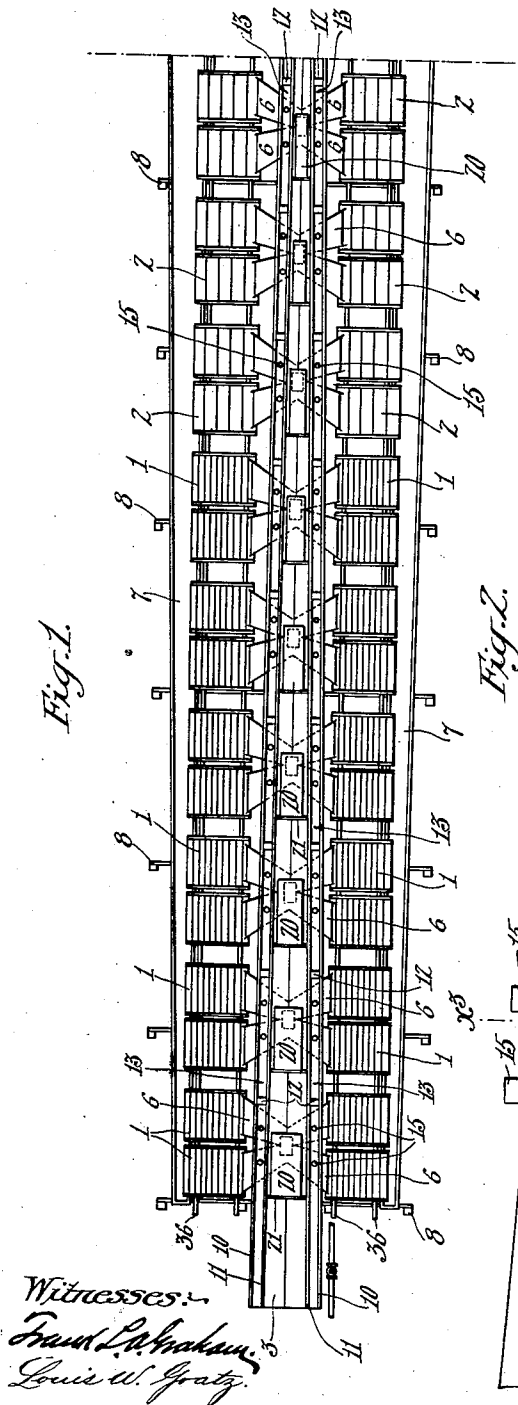
E. S. HOYT.
 APPARATUS FOR SEPARATING GOLD AND OTHER METALS FROM SAND, &c.
 APPLICATION FILED JUNE 2, 1908.

1,064,223.

Patented June 10, 1913.

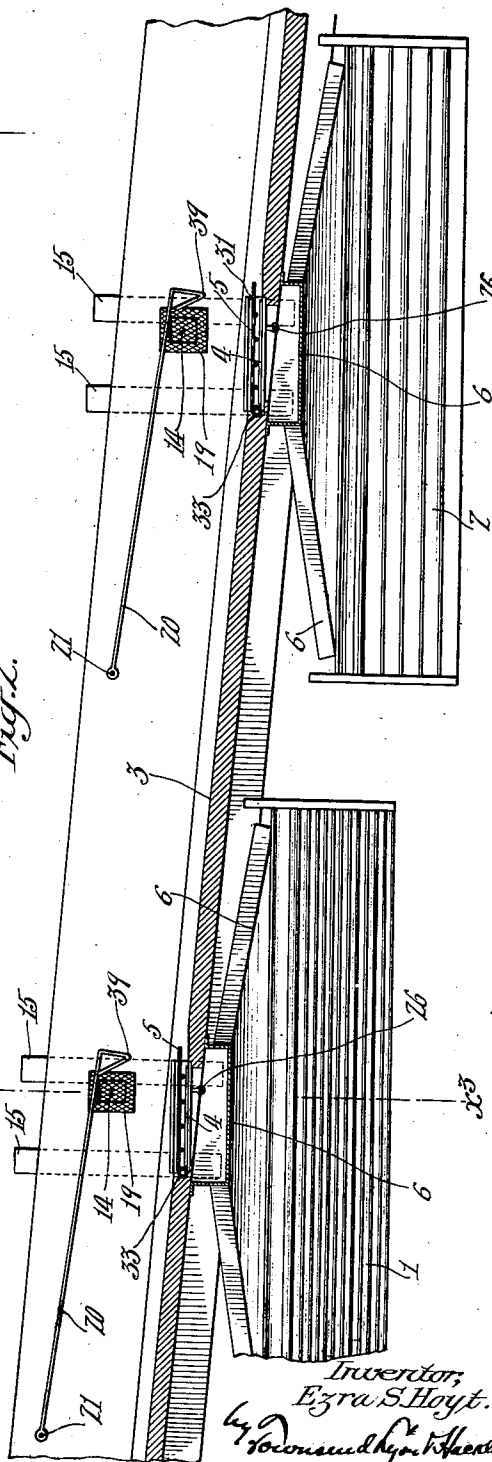
3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
 Frank L. Mahan,
 Louis W. Gratz.

Fig. 2.



Inventor,
 Ezra S. Hoyt.
 by Thomas M. Hoyt, Attorney.

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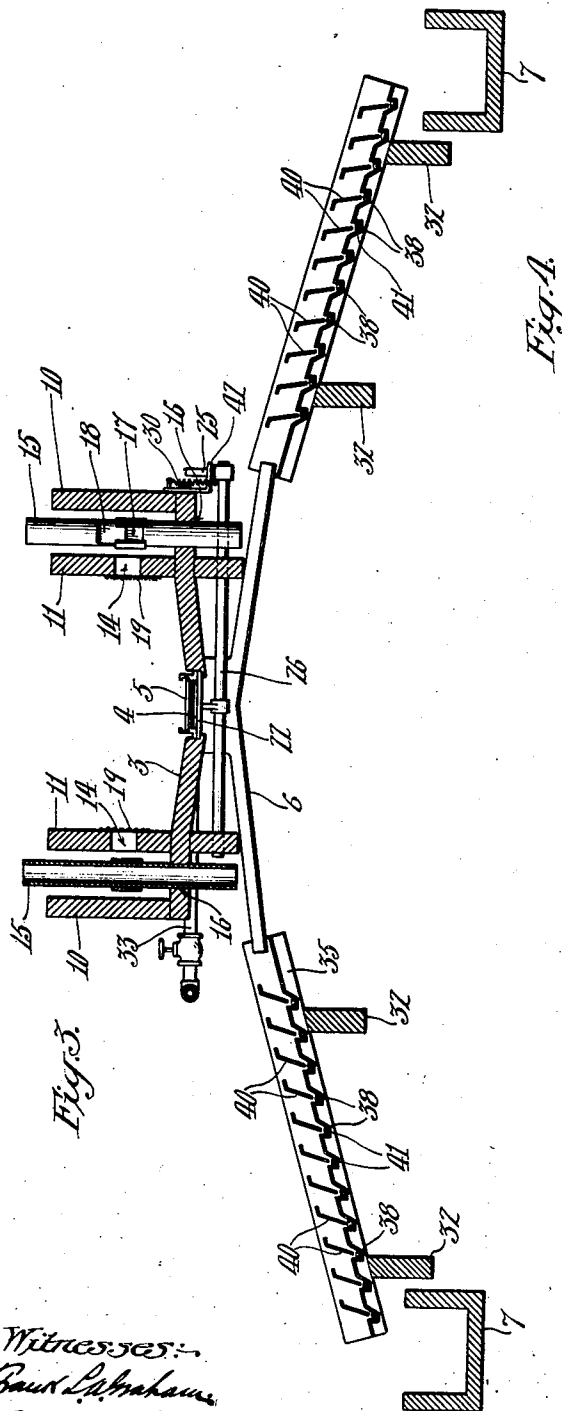


Fig. 3.

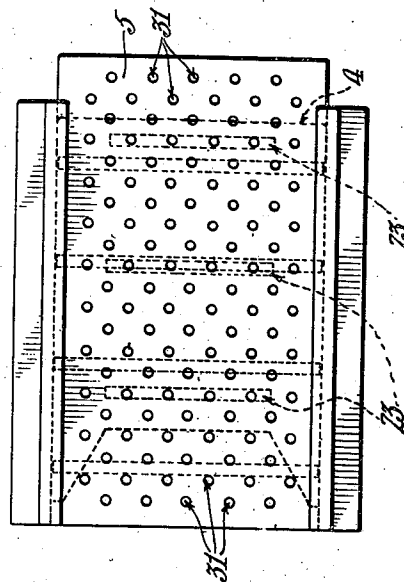


Fig. 4.

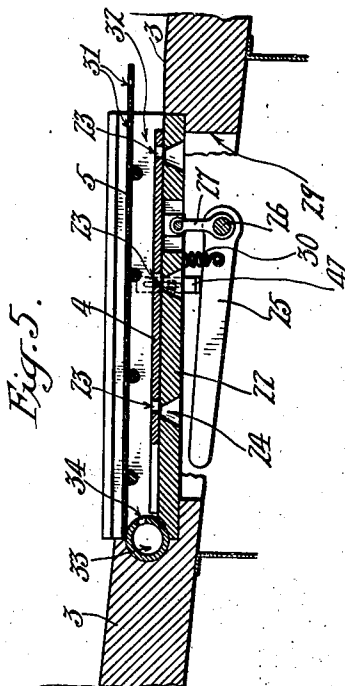


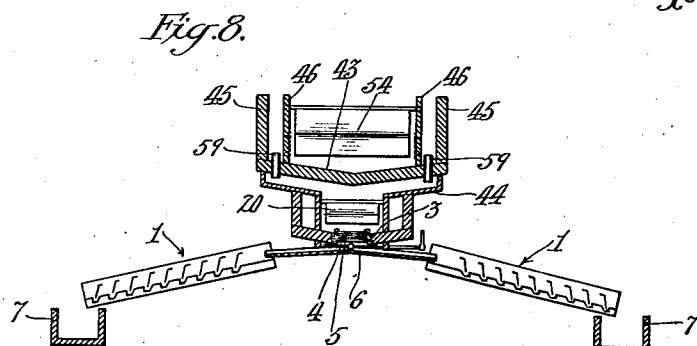
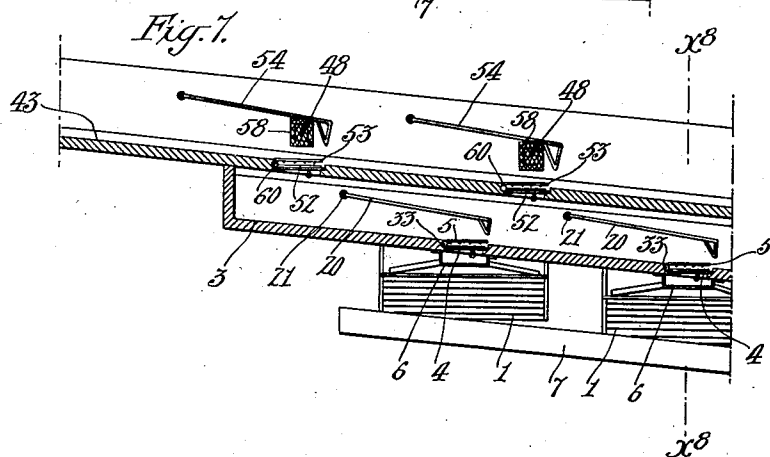
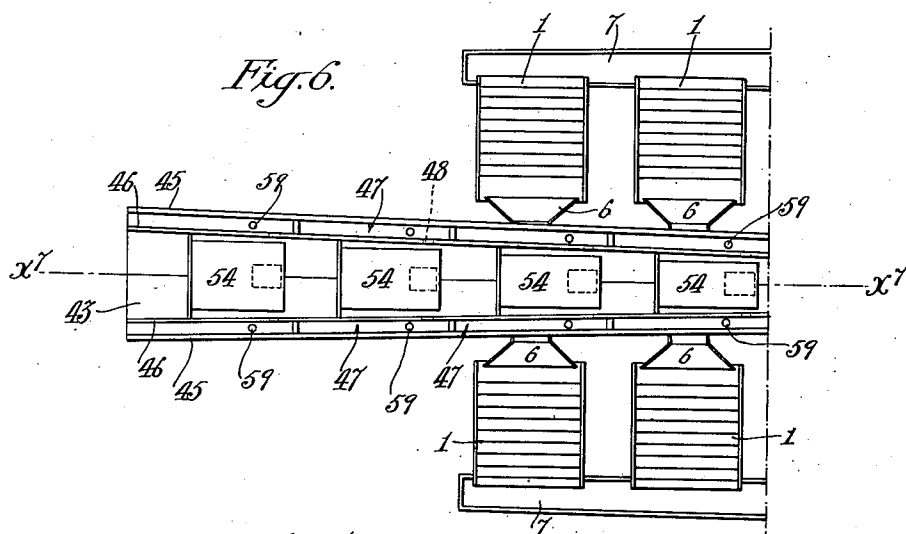
Fig. 5.

Witnesses:
 Paul L. Mahan
 Louis W. Gratz

Inventor:
 Ezra S. Hoyt.
 by Townsend Lyon Haeckel
 His Attorney

1,064,223.

3 SHEETS—SHEET 3.



Witnesses:-
Frank L. Mahan;
Louis W. Gratz

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Attorneys

UNITED STATES PATENT OFFICE.

EZRA S. HOYT, OF SAN LUIS OBISPO, CALIFORNIA.

APPARATUS FOR SEPARATING GOLD AND OTHER METALS FROM SAND, &c.

1,064,223.

Specification of Letters Patent.

Patented June 10, 1913.

Application filed June 2, 1908. Serial No. 436,265.

To all whom it may concern:

Be it known that I, EZRA S. HOYT, a citizen of the United States, residing at San Luis Obispo, in the county of San Luis Obispo, State of California, have invented a new and useful Apparatus for Separating Gold and other Metals from Sand, &c., of which the following is a specification.

This invention relates especially to means for separating gold from gold bearing sand or gravel, pulp, mill tailings, &c., although the principle of the invention is applicable in other connections.

The main object of the invention is to provide means for handling a large quantity of material, for separation of gold therefrom, at minimum expense.

Another important object of the invention is to provide for practically complete recovery of the flake or flour gold in the sand, pulp and tailings.

Another object of the invention is to provide in a single machine for successive recovery of the fine gold and of the coarse gold.

Another object of the invention is to provide a gold saving apparatus wherein the final separation is effected by separating units which can be added to, in any particular case, according to the requirements of the material being treated.

Another object of the invention is to provide in connection with such a multiple unit separating apparatus, special distributor means which will supply the ore and water successively to the units, dividing the ore between the several units in a continuous and automatic manner.

Another object of the invention is to provide means for automatic regulation and control of the ore and water supply to the units.

In the accompanying drawings:—Figure 1 is a plan of the apparatus. Fig. 2 is a longitudinal section of the separating units at the line of division between the fine and the coarse gold separating parts of the machine. Fig. 3 is a transverse section on line x^3-x^3 in Fig. 2. Fig. 4 is a plan of a screen and movable slide valve or gate for controlling the passage of the material to the separators. Fig. 5 is a vertical longitudinal section thereof. Fig. 6 is a plan of the receiving end portion of a modified form of the apparatus. Fig. 7 is a vertical sec-

tion on line x^7-x^7 in Fig. 6. Fig. 8 is a vertical section on line x^8-x^8 in Fig. 7.

Referring to Fig. 1, the apparatus comprises a plurality of riffle or separator units 1, 2, arranged in pairs in two parallel rows, each row comprising a first set or plurality of units 1 for treating the finer material and a second set of units 2 for treating the coarser material. A launder or flume 3 extends between the two rows of separators and somewhat above the level of the same, said flume having openings along its course in its bottom, there being one opening for each pair of separator units, and slide valves or gates 4 are provided at these openings for controlling the passage of material there-through, a screen 5 being provided over each slide valve or gate. Said slide valve or gate discharges onto a distributing means 6 for conveying the material to the upper end of the respective units, and said units discharge onto any suitable means such as flumes or troughs 7 extending along each side of the machine. All of the above parts are arranged on and supported by a suitable frame 8.

The flume 3 is provided with supplementary side walls 10 spaced from the inside walls 11 of the flume 3 by spacing blocks or partitions 12, thus dividing the space between the walls 10, 11 into pockets or compartments 13 which communicate with the main flume 3 through openings 14 in the inside walls 11. Screens 19 extend over openings 14. Water feed regulating pipes 15 extend and fit in openings 16 in the bottom of the compartments 13, said pipes being opened at each end and having an opening 17 in the side through which water can pass therethrough, said water discharging through the bottom of the pipe onto the distributing means 6. Each pipe 15 is vertically slidable in the opening 16 so as to enable the level of the water inlet opening 17 to be adjusted according to the requirements, and is provided with slidable gates or closures 18 for the opening 17, to regulate the water supply to the riffle units.

A floating drag or deflector plate 20 is hinged or pivoted in the flume 3 as by means of a rock shaft 21 journaled in the side walls 11 of same flume, the said drag extending from and secured to said rock shaft and having its forward end bent or shaped to present a forwardly and downwardly inclined

face or lip 39 to the water and material traversing the flume, this portion of the drag being directly over the discharge slide valve or gate 4, so that the flume serves to concentrate the flow and scour, and to maintain a definite head and quantity of water at the gate independent of temporary variations in the supply.

The discharge slide valve or gate 4 consists of a sliding plate movable longitudinally on a seat or stationary plate 22, the said two plates having transverse slots or openings 23, 24, which register when the gate is fully open and can be brought out of register by moving the slide plate 4 to close the gate, this operation being effected by a lever 25 on a rock shaft 26 and an arm 27 thereon connected to the plate 22. A spring 30 tends to draw the gate to closed position, this movement being arrested by an adjustable stop 42, which is set for the proper delivery of fluid, so that when it is desired to flush the gate, the lever can be pulled to open position and allow a full run of water through the gate, clearing the gate. On then releasing the lever the gate is pulled to normal position by the spring. The valve plate 4 and its seat plate 22 are arranged in a recess 29 in the bottom of the flume 3 so that they are somewhat below the general course of the water in the flume, and the screen plate 5 is placed at the top of said recess flush with the bottom of the flume, said screen plate having openings 31 of a sufficient size to permit the passage therethrough of material of a fineness suitable for the operation of the riffles. The aforesaid parts, namely, the gate and the screen, are located at the mid-width of the flume and the bottom of the flume dips upon each side toward the mid-width of the flume so that there is a constant tendency of the material to settle or wash to the middle and onto the discharge screen and gate. The flume 3 inclines continuously from its upper to its lower end, the successive riffle units 1, 2, being at successively lower planes and the side walls of the flume converge from the upper toward the lower end. The gates 4 and their seats 22 are horizontally arranged, and the screens 5 extend horizontally over the valve plates 4, the said screen plate being flush at the side of the rear end with the bottom of the flume and extending at a level sufficiently above the valve plate 4 to form a passage 32 between the plates 4 and 5. A water supply pipe 33 extends transversely of the bottom of the flume below the screen plate 5, near the rear end thereof, and is perforated at 34 and supplied with water under sufficient pressure to discharge or force a current of water between the screen plate and the gate plate 4.

The distributing means 6 consists of a pan or plate dipping or inclining from its

mid-width toward each side and comprising four diverging portions leading to two associated riffles or separator units 1 or 2 on one side and to corresponding units 1 or 2 on the other side of the apparatus.

Each of the separator means 1 may consist of a bottom plate 37 extending between side plates 35 resting on stringers 36, said bottom plate 37 being preferably formed of a sheet metal stamped or pressed to form a series of wells or depressions 38, these wells being separated by a plane or flat portion of the plate 6 and each well having its side walls or faces converging downwardly. Between side walls 35 extend deflectors or baffle plates 40, said deflectors extending obliquely downward into the wells 38.

The riffle units 2 are similar in construction to units 1, but are of larger dimensions, as regards the depth of the passages allowed for the water and material, and the height and distances of the deflectors, etc., being so proportioned that they are adapted to operate with, and separate, material of larger size than is supplied to the riffle units 1, and the screens over the gates for the riffle units 2 are made with larger perforations than with the screens for riffle units 1, as shown in Fig. 2.

The operation is as follows:—Gold bearing or metal bearing sand or gravel, pulp or mill tailings, etc., is sluiced into the flume 3 by any suitable means, and owing to the inclination of said flume the material travels longitudinally in the flume passing successively over the discharge gates 4. The screens 5 of the respective discharge gates are perforated in such manner that the smaller particles or components of the material pass through the first set of screens and deliver onto the first set of riffles or separator units, and each discharge gate 4 is set to take only so much of the material as its corresponding riffle or separator unit can effectually handle. The surplus of material passing through the screen, and not taken through the gate 4, is washed out by the jet of water between the screen and the gate. Each gate therefore withdraws from the body of material passing in the flume a definite proportion of the material, the total amount of material being thus decreased by successive abstractions. By this means the material passing the flume is finally cleared of all the finer material and the succeeding screens in the flume are perforated in such manner to allow a coarser grade of material to pass therethrough, these screens taking successive portions of such material until this coarser grade is in turn completely removed from the body of material passing. The material discharged from the end of the flume will contain only gravel and other coarse material and may be passed to any suitable means for further treatment, if

desired. The material is thus subjected successively to the action of finer and coarser screens for removing successively finer and coarser grades of the material, so that each riffle will have a uniform grade or fineness of material to operate upon, this being preferable for the effective operation of the riffles. Especially will these screens and concentrating flume take the black sand and gold from gravel, etc., passing the concentrates (black sand and gold) over the riffles, where the gold is separated from black sand.

It will be understood that more than two sets or grades of screens may be used if desired. In each set or grade of screens there are a plurality of gates taking successive portions of the material of the corresponding grade and distributing it to different riffles or separator units, so that the amount apportioned to each unit will be in exact correspondence with its capacity. While the material is being supplied to the riffles in this manner, a corresponding definite amount of water is supplied to the riffles by means of the pipes 15, the closures 18 for said pipes being adjusted to permit exactly the proper amount of water to flow to each riffle in correspondence with the amount of material supplied to the riffle and with the capacity of the riffle. The drag 20 forms a yielding obstruction in the path of the material in the flume, so that the material and the water are held down toward the screen, thereby producing a damming up of the material and water at the screen so that an extra head of say about 3 inches is provided, and the consequent increase in depth of the water at this point acts in the first place to increase the pressure, driving the material through the screen, and in the second place, by increasing the cross section, acts to retard the flow over the screen, giving more time for the material to pass through the perforations of the screen. The forward bottom edge or lip 39 of the drag 20 extends straight crosswise of the flume, and acts in conjunction with the central dip of the flume to concentrate the flow at the screen so as to keep the screen clean. The said drag also, by holding back the water, maintains a sufficient supply or head of water above the gate to insure delivery of water through the openings 14 into the packets or compartments 13 for supplying the riffles through the water feed regulating pipes 15. Moreover, in case of temporary fluctuation in the water supply, these floats by backing up the water maintain a sufficient head for the uniform operation of the riffles during the fluctuation.

The material discharged onto each pan or distributing plate 6 passes therefrom, together with the water coming through the water feed regulating pipes 15, onto the

riffle or separator unit 1 or 2, the material and water passing onto the bottom plate 37 and being caught by the first deflector 40 so that a small quantity of water is accumulated back of the deflector, and the water and material pass down into the well or depression 38 under a small definite head of water, say about two inches. The water and material thus pass downwardly on top of the body of mercury 41, at the bottom of the well or depression 38, with a definite velocity normal to the surface of the mercury. The inclination of the bottom plate and the dimensions of the well and of the deflector are such that the velocity of the water in passing over the body of mercury is not sufficient to disrupt the mercury or to overcome the surface tension of the mercury. As the material, together with the water, encounters the deflector and is deflected downwardly, an eddying action results which separates the masses of the material so that each individual particle of sand, etc., is separately suspended in the water, and this condition is maintained during the entire passage of the material and water through the riffles. All of the materials so suspended in the water are heavier than the water, and as the combined body of water and material passes downwardly onto the body of mercury, and is then deflected by the body of mercury, the heavier materials will tend to continue in their downward motion by virtue of their momentum, so that each individual particle of solid material, heavier than water, will on reaching the body of mercury exert a downward pressure which is in excess of the general pressure due to the head or static pressure of the water. This downward pressure of each particle of material, encountering the surface of mercury, is proportional to the specific gravity of the material and therefore is greatest in the case of heavy metals, such as gold, etc. Each particle of solid material thus produces at a point where it strikes the mercury surface, a localized static pressure normal to the surface which tends to drive the particle or body into the mass of mercury, and by properly proportioning the inclinations and dimensions of the parts, the static pressure so operating to force the solid particles into the mercury, against the resistance offered by the surface tension thereof, can be made such that only materials of a specific gravity greater than a certain amount, will penetrate the mercury. For example, in case of black sand containing gold and other heavy metals, the proportions will be such that the momentum imparted to the black sand will not be sufficient to enable it to break through the skin of the mercury, but in case of gold and other metals, heavier than black sand, the momentum will be sufficient to cause the metal to

penetrate the body of mercury, and be amalgamated therein or to be either retained therein, free milling gold will under such circumstances be amalgamated in the mercury, and gold which is so coated or constituted as not to be capable of being amalgamated in mercury, will by virtue of its greater specific gravity and its downward velocity pass to the bottom of the mercury and be there retained. As the material and water pass successively to the wells or depressions of the riffles, a further amount of the heavy metal is taken out at each step until the residue is discharged into the waste flume substantially free of values.

While the explanation above has been mainly for gold saving it will be understood that the same principle is applicable to any heavy substance. The operation of the first set of gates 4 clears the body of material in the flume from all the finer grades, so that the material is left in shape for effective treatment of the coarser grade of material by the second set of riffles, this being necessary in order to avoid packing of the riffle by the passage therein of a grade of material finer than is adapted to the conditions of velocity, etc. at that riffle. In this connection it may be stated that the principle of forcing the heavier particles into the body of mercury by virtue of their momentum, provides a partial but not perfect compensation for variation in size, for the larger the size of a particle of a definite specific gravity, the greater will be its mass and therefore its momentum, for the definite velocity in the riffle; and the area of the particle and of the surface of mercury which has to be opposed and broken by the particle also increases with the size of the particle, but not in the same proportion as the mass. It is therefore important to segregate the material into grades of different fineness so that each grade of material can be worked in a riffle with a velocity or static head approximately proportioned to the size of the particles.

In some cases, particularly where a low grade of material is being worked, it is desirable to subject the material to preliminary concentration before it passes to the distributing flume 3. For this purpose a supplementary or preliminary concentrating flume is provided as shown in Figs. 6 to 8, said supplementary flume 43 extending over the top of the flume 3 and resting thereon or on intermediate members 44. Said members 44 are inclined toward the center of the distributing flume 3 and at their outer ends extend upwardly to support the bottom of the concentrating flume 43. The bottom of said concentrating flume also inclines toward the mid-width thereof and has upwardly extending side walls 45 and inner side walls 46 forming pockets or compart-

ments 47 communicating with the body of the flume by openings 48 in said inner side walls.

A series of openings provided with gates 52 and screens 53 similar to the gates 4 and screens 5 above described, are provided along the course of the flume 43, and for each screen a floating deflector plate or drag 54 is provided, hinged in the upper flume and extending over the corresponding screen, the lower or rear end of this deflector plate being formed to present a surface oblique to the direction of motion of material in the flume. The openings 48 in the inner side walls 46 of the upper flume 43 are located between the level of the screens 5 and the deflectors 54 so that the water passing down the upper flume and encountering said deflectors will be forced partly through said openings 48, the latter being protected by screens 58 to prevent gravel, etc. from being carried through into the water supply pockets 47. From each water supply pocket 47 a pipe 59 leads through the bottom of said pocket downwardly into the space beneath the upper flume, said pipes discharging onto the intermediate members 44 aforesaid.

Water supply pipes 60 are preferably provided at each gate for clearing the space between the gate 52 and the screen 53 above the same. The lower flume 3 and the riffle units are as above described. In the operation of this form of the invention, the material supplied into the upper flume 43 is carried downwardly in the same over the successive screens 53. Any material which is too large to pass through the screens is simply carried along and discharged at the lower end. Light material, even if small enough to pass through the screens, is mostly carried forward by the entraining action of the water and discharged at the lower end of the upper flume, but such of the heavy material as is small enough to pass through the screens is discharged through the screens and gates into the lower or distributing flume 3 where it is acted upon as above described. The supplementary or upper flume thus provides for the initial concentration and elimination of a large proportion of the waste material, thus increasing the capacity of the distributing and riffle means.

What I claim is:—

1. The combination with a riffle unit, of a distributing flume having a concave bottom with an opening therein, a screen at said opening, a gate beneath said screen controlling the flow through the screen, said gate being spaced from the screen, means for supplying water between the screen and gate, and means for conducting the material from the gate to the riffle unit.

2. The combination with a riffle unit, of a distributing flume having an opening in its

bottom, a screen for said opening, a stationary plate extending under and separated from the screen, and having openings, a movable stationary plate having openings to register with those of the gate plate, and provided with manual operating means, means for supplying water between the screen and the gate plate, and means for conducting material from the openings in the stationary gate plate to the riffle unit.

3. The combination with a riffle unit, of a distributing flume provided with an opening at the bottom, said flume being inclined from end to end, a horizontal screen at said opening, one end of the screen being substantially on a level with the bottom of the flume and the other end of the screen being above such bottom a distance corresponding to the drop of the flume in the length of the screen, forming an opening between said end of the screen and the bottom of the flume, a gate beneath said screen, means for conducting material from the gate to the riffle unit, and water supply means extending into the space between the screen and the gate at the end farthest removed from the aforesaid open space to deliver a current of water through said space.

4. The combination with an inclined flume, a horizontal perforated gate seat in the bottom thereof, a horizontal perforated gate plate sliding on said gate seat, a horizontal screen above the gate and separated therefrom, the space between the seat and gate opening at one end onto the bottom of the flume, and a water supply pipe opening into said space at the other end thereof to supply a current of water through said space.

5. The combination with a riffle unit, of a flume having a gate, said gate being adjustable to control the supply of material therethrough, means for conducting material from said gate to the riffle unit, a screen for the gate, said screen being above the gate and located in the bottom of the flume, a regulatable water supply connection from the flume at said gate discharging onto the riffle unit, and deflector means extending over said screen to confine the flow of water toward the screen and to control the supply of water from the flume to the water supply connection, said deflector being pivoted to the flume and extending from its pivotal point longitudinally over the screen and in a down-stream direction.

6. The combination with a riffle unit, of a flume having a gate in its bottom, a floating deflector in the flume over said gate, and means for receiving and conducting to the

riffle unit the material passing through the gate.

7. The combination with a riffle unit, of an inclined flume having an opening, a screen in said opening and located at the bottom of the flume, a gate beneath said screen, means for conducting the material from the gate to the riffle unit, and a deflector over said screen, said deflector being adjustably supported in the flume to dam up the flume over the screen, whereby an additional head is provided over the screen for forcing the material through the screen.

8. The combination with a riffle unit, of a flume having a gate for said riffle unit, a floating deflector extending longitudinally in the flume above the gate, and separated from the gate to form a channel for the passage of water and material, and a regulatable water supply connection communicating with the flume at the side of said channel, to receive water from the flume, and to deliver water to the riffle unit.

9. The combination with a riffle unit, of a flume having an opening in its bottom for said riffle unit, a screen for said opening, means for directing the material and water from said opening to the riffle unit, and a deflector pivoted in the flume at said gate and extending from its pivoted portion longitudinally of the flume over the gate in the down-stream direction of the flume, the down-stream end of said deflector being free to move vertically.

10. The combination of a flume having a gate along its course, in the bottom of the flume, a floating obstructing device extending above said gate to maintain a definite head at the gate, and a separator unit supplied from the gate.

11. The combination with a series of riffle units, of a distributing flume provided with gates for the respective riffle units, and a concentrating flume extending over the distributing flume and having a series of screens along its bottom to discharge onto the distributing flume, said concentrating flume being provided with lateral water discharge outlets, and intermediate members between the flumes to receive the water from said outlets and lead it to the distributing flume.

In testimony whereof, I have hereunto set my hand at Los Angeles this 23rd day of May, 1908.

EZRA S. HOYT.

In presence of—

F. M. TOWNSEND,
A. P. KNIGHT,
FRANK L. A. GRAHAM.