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Bailey Gold Mining Co.

45 Broadway, New York,

October 10th, 1896.

John W. Bailey of Denver, Colorado, and myself, have a contract with Wm. J. Sutherland to work 750,000 tons of tailings at his mill at Belleville, Nevada, which can be done with a Bailey mill at a profit to us of about $2.50 per ton under our contract.

These tailings are in a pit adjacent to the mill in which they were crushed by stamps and roasted, and are the residue from the treatment in that mill, containing chemicals which have acted on them for several years, putting them in perfect condition for complete extraction by our process.

Under our contract we have the right to use such portions as we need of this Belleville plant, consisting of a large and fully equipped stamp mill with every appurtenance, together with an ample supply of water, free of charge, paying only for fuel and labor used by us in operating our mill which are small items, as comparatively little power is required to run a Bailey mill, while the labor is only nominal. A few men can deliver and feed the tailings into the mill and attend to their treatment in it.

These tailings contain quicksilver lost from former treatment worth from fifty cents to two dollars per ton of tailings all of which the Bailey mill will save, and to which we will be entitled to under our contract.

In addition to these Belleville tailings which we have the option to treat under our contract, Col. Sutherland has the option to own and operate our mill at hiscost and expense on either or all of three other mines in the vicinity, containing in the aggregate several millions tons of tailings of equal and higher grade, besides waste dumps and low grade ore amounting to several million tons more of still higher grade, by paying us as royalties all the values saved above 80% of the gold and silver assay value, which would give us from two to four dollars per ton on all ores worked by him.

A single Bailey mill will treat at least 25 tons per day requiring only 6 to 8 horse power, and the same number of men can attend several of them, say from one to six of them - as the treatment is all automatic after the ore is fed into the mill.

The Bailey mill performs the work of pulverizer, amalgamator, extraction vat and electrolytic bath in one mill and one operation.

As a pulverizer and amalgamator by gravity it is superior to the stamp mill or any other now in use. In the use of cyanide, chlorination and all other solutions, and precipitation by chemicals or by electrolysis it has all the merits of these separate operations as now practiced by others, besides some important advantages arising from the combination of all of them in one mill and one operation. What it does not save by gravity, amalgamation, it saves by solution and precipitation. This is its record in practical operation.

Mr. Bailey has had over twenty years of experience in the treatment of gold and silver ores, having built, owned and operated many stamp and other mills, for his purpose, some large ones, and is perfectly familiar practically with every phase of the business in the treatment of all kinds of ores, and is a thorough chemist, minerologist, and business man and above all honest and industrious. While he is the inventor and patentee of the mill it is not a discovery or invention in the ordinary sense, but the adaption of the machinery necessary in combining the pulverizing, amalgamating, solution and electric precipitation in one mill and one automatic operation as a result of his long and extensive experience.

45 Broadway, New York,

September 30th, 1896.

The Bailey gold mill performs the work of pulverizer, amalgamator, extraction vat and electrolytic bath in one mill and one operation.

As a pulverizer and amalgamator it is superior to the stamp mill.

In theuse of cyanide, chlorination and all other solutions and precipitation by electrolysis it has all the merit of these separate operations, as now practiced, besides some important advantages arising from the combination of all of them in one mill and one operation.

In the treatment of oxidized ores where stamp mills save only 40 to 60 per cent it will save from 98 per cent to only a trace, although all the gold in what are considered absolutely free milling ores when it is well known that stamp mills in no case save it all, because amalgamation in a stamp mill depends on gravity which does not bring all the gold in contact with the mercury even if it were in condition to be acted on by it.

Ores containing non-amalgamable sulphides, tellurides, etc., are first treated in this mill to obtain all the values that can be saved by gravity, amalgamation, solution and precipitation and the remainder passed through additional stages of treatment, described below, but in all cases the treatment is continuous, automatic and rapid from commencement to finish, and the extraction complete.

The whole operation briefly stated is:

1st. The pulverization of the ore and the separation of the gold and silver by gravity, amalgamation, solution and electrolysis, in one act in the pulverizing mill, which effects complete extraction of free milling and oxidized ores, and a large percentage of the values of ores containing non-amalgamable sulphides, tellurides, etc.

2nd. In ores containing sulphides, tellurides, etc., the separation of the non-amalgamable portion from the sand, slimes and water.

3rd. The separation of the worthless sand from the slimes and water.

4th. The separation of the slimes from the water.

5th. The separation of the remaining values from the water by electrolysis or precipitation.

It is well known that when ores are pulverized the heavier particles of free gold can be separated by gravity, and caught by contact with mercury, amalgamation, that it can be dissolved by solutions of chlorine, bromine, cyanide or by various chemical combinations, etc., and that the gold can be precipitated from such solution by proper precipitants, and by electrolysis. But as gravity on which the stamp mill solely depends for amalgamation does not bring all of the free gold in contact with the mercury, especially the lighter particles, such as float gold, etc., this and much or all of the gold contained in some ores not being in condition to be acted upon by the mercury are dissolved by these solutions and caught by precipitation, heretofore requiring plants and appliances separate from and beyond the stamp mill or pulverizer, which usually cost as much as the pulverizer itself. But in no process heretofore has it been accomplished or tried in one mill and one automatic operation, or done as cheaply, or to as

high a percentage in saving values, as in this mill where all these are combined in the pulverizer.

The ore is first crushed by a Gates or other suitable crusher and automatically fed down over plates in such a manner that the finest particles of ore containing gold are immediately subject to amalgamat on. After falling through the solution the coarser particles are pulverized between the shoe and die of the pulverizer and driven down into the mercury for amalgamation, while the rising solution carries up the finely divided rock and discharges it through the overflow.

The solutions used for extraction are fed in to the mill under regulated pressure from a tank and vary somewhat in composition and strength according to the character of ore to be treated - and are used only to dissolve the impalpable auriferous powder. The larger particles are caught by the united action of gravity and electrical difference of potential propelling them to the mercury.

In flour gold, whether amalgamable or not, the saving is very high on account of the action of the cyanide of potash acting as a cleansing agent and also a solvent.

By combining all these processes in the pulverizer the cost of plant and treatment are greatly reduced and the product increased practically to complete extraction.

The cost of treatment including pulverizing and extraction ranges from 60 cents to $1.50 per ton according to capacity of plant, character of ore, cost of fuel, labor, etc.

The capacity of a single mill or pulverizer is 20 to 30 tons per day, varying with the character of ore, and will average about one ton per hour, hence the amount of ore treated by a Bailey plant in a given time depends on the number of these mills in the plant.

A plant consists of the mill, a dynamo, a crusher, for preliminary crushing to reduce the ore to a convenient size before feeding it into the mill, and an engine and boiler. A small Gates crusher will crush enough ore for two mills or pulverizers, and a large one enough for four.

The cost of a complete plant to treat any required quantity per day is as follows - f.o.b. Milwaukee:

20 to 30 tons per day:

1	Mill complete, with electrical plant.....	$1,500
	Gates crusher, small size.....	450
	Engine and boiler.....	1,000
		$2,950

30 to 60 tons per day:

2	Mills.....	$3,000
	Gates crusher, small size.....	450
	Engine and boiler	1,500
		$4,950

100 to 120 tons per day:

4	Mills.....	$6,000
	Gates crusher, large size.....	600
	Engine and boiler.....	2,000
		$8,600

To the first cost of the mill freight must be added from Milwaukee by rail to the most convenient point thence by team to the place of erection. By rail to a few points is as follows:

From Milwaukee to Denver..... .92
" " " Salt Lake City.....1.40
" " " Boise City.....1.79
" " " Deadwood.....1.22

Weight of 25 to 30 ton plant:

1	Mill complete.....	16,500 lbs.
	Dynamo.....	1,000 "
	Gates crusher, small size.....	5,500 "
	Engine and boiler.....	16,000 "
		39,000 lbs.

Weight of 50 to 60 ton plant:

2	Mills.....	33,000lbs
	Dynamo.....	2,000 "
	Gates crusher, small size.....	5,500 "
	Engine and boiler.....	23,000 "
		63,500 "

Weight of 100 to 120 ton plant:

4	Mills.....	66,000 lbs
	Dynamo.....	4,000 "
	Gates crusher large size.....	8,000 "
	Engine and boiler.....	30,000 "
		108,000 lbs

It requires not exceeding 8 horse power to drive each pulverizer to its fullest capacity, 1 to 2 horse power for each small dynamo and about 4 horse power for a dynamo large enough for four pulverizers, 8 horse power for a small Gates crusher and 12 for a large one.

Each mill or pulverizer (battery as it would be termed in the stamp mill) includes an iron frame machine with a 36 inch pulverizing muller, counter shafts, pulleys and everything ready to set on foundation and belt from the engine. It needs no framing except for bins and foundation.

To house and install the plant is much less than the ordinary stamp mill of the same capacity.

The entire work in the mill is automatic requiring no attention to the ore after being placed in the bin.

Two men, the engineer and the attendant, are all that are necessary to run a plant whether composed of one pulverizer having a capacity of 20 to 30 tons per day or four with a capacity of 100 to 120 tons per day.

The wearable parts are all replacable and being made of mild steel the wear is reduced o an unimportant minimum.

The ore is pulverized by granulating which avoids sliming, instead of grinding it which not only slimes but is hard on the wearable parts.

There is no dust or other loss of ore in pulverizing, and the pulp is in better form for extraction.

The arrangement for drawing off charged quicksilver is such that while it is under lock and key yet can be drawn off at pleasure strained and recharged while the mill is running without stopping it.

A very important feature in this mill over all others is the fact that the mill can be shut down at pleasure whether loaded or not, and started up again without having to shovel it out.

It requires only half the water used in a stamp mill for the reduction of ore, besides the water may be used over and over again.

The mill consists of a round outside pan 3 feet high by 4 feet in diameter of 1 1/2 inch iron, around the bottom of which is a mercury groove 4 inches wide of graded depth. Concentrically within this pan is a steel wearing plate upon which the pulverizing muller gyrates. The bottom of the pan is conically depressed in the center to make in the solution reservoir hydrostatic pressure which balances the weight of muller and shaft. Resting in the bottom of the pan and held in place by set screws is a mild steel ring 2 1/2 inches by 6 inches in section and 40 inches in internal diameter. Within this rolls the muller rimmed with a removable shoe of mild steel 2 1/2 inches thick and of 36 inches external diameter. The muller weighs about 1100 pounds. It is given 200 revolutions per minute by an adaptable eccentric attached to the shaft and this exerts a centrifugal pressure of about 6 tons. The electrolytic action is carried on between the anode, a truncated cone of iron, and two cathodes. A cone of amalgamated 1/16th inch copper forms the upper cathode and mercury insulated from the groove the lower.

The ore is pulverized to a very fine degree in water charged with a solution that is a solvent of gold. The water and solution are mixed in proper proportions and is fed in at the bottom through a pipe regulated by a valve, and flows out at the top of the mill through a discharge pipe. Therefore the ore is pulverized in a rising current of water, which floats off the fine light stuff as fast as it is pulverized fine enough to float. The coarse gold by its gravity remains in the mill and is absorbed by the mercury cathode at the bottom of the mill and the lighter particles of gold floating near the top are largely caught on the copper plate near the top of the water which is also a cathode coated on both sides with mercury. While the ore is being pulverized it is also being acted upon by the solvent electrolyte, and as fast as it becomes an auric solution, is decomposed by the current of electricity, and the precious metals are deposited in, or on, the cathodes. The solvent solution is a cleansing agent on the gold, greatly aiding the amalgamation. One of the main objects is to catch as much of the gold as possible by gravity and by amalgamation. Which is by this method practically all the gold in free milling and oxidized ores and usually 80 to 90 per cent in ores containing sulphides, and tellurides, leaving as little as possible for the slower and more expensive dissolving and precipitation part of the process. Because it is well known that coarse gold dissolves very slowly, and it is a source of much loss in time in the cyanide and other processes where all the gold must be dissolved before it can be precipitated. Therefore in this first stage of the proceedings this mill secures the gold by gravity, amalgamation, and electrolysis.

But as the water is continuously flowing in at the bottom and out at the top of the mill it may float off some particles not yet dissolved, and all of the sulphides and tellurides containing gold and silver not amalgamable nor in condition to be acted upon by the solvent solution are passed through and it is to save these values that the stock is further treated by very simple but effective appliances which can be built at the mill at very small cost, and which extend the operation automatically to complete extraction of these remaining values.

The first step, constituting the second stage of the process, wherein this extended treatment is necessary, is the separation of the heavy sulphides from the sand and water on a rocking separating table or concentrator with an endless belt

Bailey Gold Mill Company,

45 Broadway, New York,

April 5th, 1897.

The Bailey gold mill combines pulverizer, amalgamator, solution and electrolysis, all in one mill and one automatic operation.

Reduces cost of plant, operating expenses and treatment, and increases extraction.

The ore is pulverized to any degree of fineness required for its perfect treatment.

The quicksilver is directly under the pulverizing surfaces and the pulverizing and amalgamation take place in a solution of cyanide of potassium, which acts as a cleansing agent of both the quicksilver and the gold, and being within the field of electrical action the amalgamation of the coarser gold is complete, while the gold fine enough to float is dissolved by the solution and precipitated by the current into the mercury.

In the treatment of oxidized ores where stamp mills save only 40 to 60per cent of the gold, this mill will save from 98 per cent to only a trace, and saves all the gold in what are considered free milling ores, where it is well known that stamp mills rarely save more than 80 to 90 per cent.

The solution being constantly in the field of electrical action where the quicksilver is the negative pole, or cathode, all the gold, which has not been secured by gravity, is deposited into the quicksilver by the current the instant it is dissolved, doing away entirely with the cumbersome, slow and expensive solution vats and zinc shavings

precipitation boxes of the Mac Arthur-Forest process, or the equally bulky and expensive solution and electrolytic precipitation tanks of the Siemens-Halske system, besides securing a higher percentage of extraction and saving of the gold. All the gold dissolved in the solution is saved, but in the cyanide processes much is lost in recovering it from the solution.

Many forms of sulphuret ores not amenable to treatment by the stamp mill or the cyanide procession can be treated to a high degree of extraction in this mill.

The mill consists of a round outside pan 2 feet high by 4 feet in diameter of 1 1/2 inch iron, around the bottom of which is a mercury groove 4 inches wide of graded depth. Concentrically within this pan is a steel wearing plate upon which the pulverizing muller gyrates. In the bottom of the pan is a mild steel ring 2 1/2 inches by 6 inches in section and 40 inches in internal diameter. Within this rolls the pulverizing muller rimmed with a removable shoe of mild steel 2 1/2 inches thick and of 36 inches external diameter. The Muller weighs about 1100 pounds. It is given about 200 revolutions per minute by an adaptable eccentric attached to the shaft and this exerts a centrifugal pressure of about 6 tons. The electrolytic action is carried on between the anode, a truncated cone of iron, and two cathodes. A cone of amalgamated 1/16th inch copper forms the upper and the mercury the lower cathode.

directly over a trough of mercury

The ore is pulverized in water charged with a solution that is a solvent of gold and within a field of electrical action. The water and solution are mixed in proper proportions and fed in at the bottom through a pipe regulated by a valve, and flow out at the top of the mill through a discharge pipe, or through screens at the side. Therefore the ore is pulverized in a rising current, which floats off the fine light stuff as fast as it is pulverized fine enough to float. The coarse gold by its gravity remains in the mill and is absorbed by the mercury cathode at the bottom of the mill and the lighter particles of gold floating near the top are largely caught on the copper plate near the top of the water which is also a cathode coated on both sides with mercury. While the ore is being pulverized it is also being acted upon by the solvent electrolyte, and as fast as it becomes a gold solution is decomposed by the current and the gold instantly deposited on the cathodes. As much of the gold as possible is caught by gravity and amalgamation. Which is by this method practically all the gold in free milling and oxidized o res, and a large per cent in rebellious ores, leaving as little as possible for the dissolving and precipitation part of the process.

The mill is in two forms, one a pulverizer, complete within itself as a pulverizer, amalgamator, solution and electric precipitation vat, as described, the other is similarly constructed, and is also complete in all these,

but in less a pulverizer and more a settler, being a combined grinding pan or pulverizer and settler with electrolysis added.

The pulverizer without screens having the overflow discharge reduces the ore to 80 or 100 fine doing complete amalgamation and electrolytic work, and as such, has a capacity of 20 to 24 tons per day, but with screens of 40 mesh through which it discharges, instead of the overflow discharge, it handles from 40 to 50 tons per day, the pulverizing and other treatment being completed in two settlers that follow.

The solution is run into the pulverizer through the bottom, and the ore is fed in at the top, hence the pulverization and other treatment are in a rising current, which passes from the pulverizer to the top of the settler, which also continues and completes the full treatment - pulverizing, amalgamation, solution and electric precipitation. The settler is larger, has less mechanical motion, costs less and requires less power, and passes the stock through slower giving more time for the chemical action in the solution.

The settler is also adapted to place below a stamp battery, or any other ore grinder now in use, where it will save most if not all the gold not recovered by them.

One Bailey pulverizer and two settlers will handle as much ore in twenty-four hours as an ordinary twenty stamp

mill which only crushes and imperfectly amalgamates, while the Bailey mill not only pulverizes and amalgamates thoroughly but includes the complete cyanide and other solution treatment in the cheapest and most effective form.

The recovery of gold in a stamp mill is confined to amalgamation of the free gold by the action of gravity alone bringing it into contact with the quicksilver. Much of the gold being too fine for gravity floats away with the water and slimes. This gold, with all sulphurets, and gold coated with impurities which prevent amalgamation, are run over concentrators and through settlers in which a considerable portion is secured for subse quent treatment. All these are avoided in the Bailey mill, which not only treats these classes of ore perfectly, but also all other ores amenable to treatment by cyanide and other solutions, besides extending the field of cyanide treatment, and shortening the time required for the solution and precipitation of the gold, and reduces the expense.

The pulverizer is a complete iron frame machine, with counter shafts, pulleys and everything ready to set on foundation and belt from the engine. No framing is necessary except for ore bins and foundation.

It weighs about 16,500 pounds including iron frame, muller and all.

The settler requires a wooden frame and pan to be

added to the iron part which weighs about 5,000 pounds.

Each pulverizer requires 6 to 8 and each settler 5 horse power.

A complete plant consists of a pulverizer, two settlers, a dynamo, a crusher, for preliminary crushing to reduce the ore to a convenient size before feeding it into the pulverizer, and an engine and boiler.

The cost of the plant and to house and install it is much less than the ordinary stamp mill complete with the same nominal capacity.

A mill with any desired capacity can be had with the addition of pulverizers and settlers, and the corresponding increased power, crushing and depositing capacity each pulverizer and two settlers being capable of treating about 40 tons of ore each twenty-four hours, more or less, owing to the character of the ore.

The entire work in the mill is automatic requiring no attention to the ore after being placed in the bin.

The wearable parts are all replacable, and being made of mild steel the wear and breakage are reduced to an unimportant minimum.

The arrangement for drawing off charged quicksilver is such that while it is under lock and key yet can be drawn off at pleasure, strained and recharged, while the mill is running without stopping it.

The mill can be shut down at pleasure whether loaded

or not, and started up again without having to shovel it out.

It requires only half the water used for the reduction of ore in a stamp mill.

M. Eissler, a mining engineer of wide experience, in his comprehensive work "The Metallurgy of Gold" states "The loss in working gold ores, even without most modern appliances, is still enormous, and even at the present day not more than one-half of the gold contained in the ore which is worked, whether by free milling or otherwise, is saved."

"One of the oldest and best authorities in California (Mr. A. B. Paul) has said upon this subject: "As far as California is concerned, I am satisfied that no more than 40 per cent of her gold is exhausted. The fact is, we are not working to save gold but to crush rock." Again he says: "Our present general system of gold mining is based upon the idea that gold is mainly coarse, while examination will show that the high percentage is in atoms finer than flour itself. In my experiments gold has been taken up so fine that in distilled water it would not precipitate in less than from five to ten minutes. Can you save gold of this kind by running water down stream? Again, can you obtain gold of this kind without minute reduction? Therein lies the secret of high assays before working and small returns after."

"Mr. Deetkin, of Grass Valley, in order to determine

the loss of gold by the mill process, has tabulated a series of assays made of the tailings of ore of the best mills in the State, which shows the loss to have been 40 per cent of the yield, of which the float loss was nearly 14 per cent."

"The actual average yield of ores milled and smelted calculated from Fassett's table of seven years' work in Colorado showed the average value of the ore by assay to be $37.97. The average value per ton saved by milling and smelting was $14.50; showing a loss of $23.47 per ton in gold and silver, or more than 60 per cent. The gold caught on the copper plates is, under the most favorable circumstances, only 50 per cent of the assay value of the ore. The gold from the blankets and in the buddle concentrator does not amount to more than five per cent, so that when treating the most tractable of these sulphurets, battery amalgamation does not secure more than 55 per cent."

All the losses here enumerated can be saved by a Bailey plant and method without any new process, or processes, only combining those well established and in general use separately, reducing the cost of plant and treatment, the combination enhancing the efficiency of the several processes combined to such a degree as to effect complete extraction.