

REDUCTION PLANT FOR PYRITIC GOLD-BEARING ORES AT GIBBONSVILLE IDAHO.

This is a modern plant now successfully employed in the extraction of gold from its ores, especially the base and refractory ores. In order to lay the foundation for an adequate conception of the factors making up the problems presented for solution in the design and operation of the plant, a brief description of the mines is given.

THE MINES.

The mines are situated at the town of Gibbonsville, Lemhi County, Idaho, six miles west of the summit of the Rocky Mountain range, where the Bitter Root range spurs off, about 35-34 North latitude and 114-6 West longitude (Greenwich), at an altitude of 4,400 feet above the sea level. Gibbonsville is marked on the maps of United States and Idaho. The railroad shipping point is Divide Station, on the Utah & Northern Railroad, 27 miles south of Butte, Montana, 80 miles distant from the mines. From this station a good wagon road, generally speaking, leads to Gibbonsville.

The veins are true fissures, cutting across the highly-tilted strata of the slate formation. They occur in one system and are substantially parallel. Their strike is east and west, dip about 70 to the north, width varying from a few inches in some up to 12 feet in places in others. The ore consists of quartz and quartzified slate, streaked and impregnated with about eight per cent of iron pyrites. The iron pyrites contain all the value, of which over 90 per cent is gold and the remainder silver. The developments were sufficiently extensive to warrant the calculation that a production of 100 tons daily of \$10 ore could be relied upon, costing less than \$3 per ton for mining, development and delivery at the mill.

The mines are operated through cross-cut adit tunnels, which undercut the veins to a depth of 600 feet below their outcrop. Cordwood costs \$2.25 delivered; charcoal, 13½c. per bushel; mining timbers, 2½c. per lineal foot for 8 and 12 inch logs, and lumber costs \$0.50 per thousand. A four-drill air compressor, run by water, furnishes power for the machine drills used in drifting. Wagon transportation of mining and domestic supplies cost one cent per pound, over the prices that the same can be laid down for at Montana common points. Miner's wages are \$3 per day; common labor \$2.50, and carpenters \$4. The reduction plant is 4,800 feet distant from the ore bins at the mouth of the main working tunnel.

From the forgoing, it will be seen that the product to be treated amounted to 100 tons daily, of ore having an average value of \$10 per ton and carrying about eight per cent of copper pyrites. By repeated experiments it had been ascertained that the ore would yield 40 per cent of its value to plate amalgamation when crushed to a pulp flowing through a 30-mesh screen. Viewed from a commercial standpoint it was estimated that the 40 per cent of value recovered by amalgamation would fully meet all the costs of mining and reduction and the fixed charges of operation, and that the eight per cent of profits would have to be made on the 60 per cent of value locked up in the refractory pyrites after the pulp had been subjected to plate amalgamation and relieved of its free gold.

In the spring of 1885 the economic solution of this problem was undertaken by the writer, who was then managing the business of the American Mining and Development Company, the owner of the mines. After a careful consideration of all conditions, a reduction plant, as described in this paper, was designed and constructed, and has, during the past year's operation, proven a success.

THE PLANT.

The plant has ample capacity for the crushing and concentration of 100 tons of crude ore, and the roasting and chlorination of 20 tons of concentrates daily, using in the operation a combination of processes in three departments, as follows.

Section 1. Stamp crushing, with amalgamation of free gold on copper plates, followed by hydraulic classification of the pulp, and subsequent concentration of the sulphurets of Frue vanners.

Section 2. Dead roasting of the sulphurets in a Pearce turret furnace, with a toasting oven annex.

Section 3. Chlorination of the roasted sulphurets in revolving barrels, and precipitation of the metallic gold from the chlorine solution.

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Section 1, Stamp Mill. The first department of the plant is the ordinary stamp mill of the California type, containing the modern automatic devices for minimizing labor, with certain modifications especially designed for the crushing, amalgamation and concentrations of pyritic ores. The building enclosing this section is 64x140 feet, built on a side hill, with 95 feet fall between the top of receiving bins and vanner floor. The foundation timbers of the building are set on solid rock, and bolted thereto, as are also the foundations timbers of the supporting frames of the heavy machinery. In operation, the ore delivered from the mine falls into the receiving bins of the mill. From these it passes by gravity, as permitted by the crushman, through the gates, over grizzlies—bar screens with 1½-in. spaces. By this operation it is divided into two sizes, one larger, the other smaller than 1½ in. The ore is further reduced by passing automatically through a Blake crusher, a trommel screen, and a pair of 36x14 Cornish rolls, to a size under 1 in. Thus reduced, the ore is delivered to the storage bins behind the batteries, which have a capacity of 300 tons. From the bins, the ore gravitates to improved Challenge feeders, which feed it automatically, as required by the batteries.

The mortars of the batteries are of the narrow, double-discharge type, having the front and rear screens inclined outward at an angle of 17 degrees. They are thus designed to facilitate the rapid crushing and delivery of the pulp, so as to prevent sliming of the sulphurets in stamping. The screen used is 30 mesh, 29 wire, Tyler steel wire battery cloth. The stamps, 30 in number, weigh 950 pounds each, with a drop of 6 to 7 in., 94 times per minute. On issuing from the battery, the pulp flows over silver-plated copper plates, set on tables with a grade of 1½ inches to the foot. On these the free gold in the pulp is caught. After passing over the plates, the pulp from the 30 stamps flows in launders to three sets of Brown's drometric sizers for classification. In each of these sets, five classifications, ranging from 30-mesh to slimes, are made. Thus classified, the pulp flows to 15 six-foot Frue vanners, divided in three sets of five each, corresponding to the sizers. The vanners of each set are adjusted for the concentration of the special classification of the pulp they are to receive. This arrangement is giving very satisfactory results in the saving effected by the vanners, as the loss in the tailings seldom reaches as high as 7 per cent of the gross value of the ore.

Section 2, Roaster.—The building covering this section is situated directly in front of, and 50 feet distant from the vanner room of the stamp mill. The main building has a round area of 64x64 feet and is 28 feet high to the eaves. Lean-tos for the annex and cooling room and floor cover an area of 64x30 feet and 64x24 feet. As already stated, the furnace is the Pearce turret furnace, with roasting oven annex. In operation, the concentrates are dumped into the elevator boot below the floor, from which they are raised to the storage bin near the roof by a belt and bucket elevator. From this bin the concentrates are delivered by gravity through an iron chute to an automatic feed hopper which is adjusted to feed the furnaces as desired.

In the furnace, while being roasted, the concentrates are mechanically stirred and carried round by rabble arms to the discharge. They are now charged into the roasting oven, where they are subjected to a reducing heat until the final traces of sulphates remaining in them are decomposed. They are then discharged, dead roasted, wet down, and delivered to the cooling floor.

Section 3, Chlorination.—The building enclosing this section has a ground area of 146x34 feet and par-

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Time Table in Effect July 1, 1896.

No. 2, PASSENGER, Daily except Sunday—	
Leaves Rossland	7:00 a. m.
Arrives at Trail	7:45 a. m.
No. 6, PASSENGER, Sunday only—	
Leaves Rossland	8:30 a. m.
Arrives at Trail	9:15 a. m.
No. 4, PASSENGER, Daily—	
Leaves Rossland	3:00 p. m.
Arrives at Trail	4:00 p. m.
No. 3, PASSENGER, Daily except Sunday—	
Leaves Trail	10:30 a. m.
Arrives at Rossland	11:15 a. m.
No. 1, PASSENGER, Daily—	
Leaves Trail	5:00 p. m.
Arrives at Rossland	5:45 p. m.
No. 5, PASSENGER, Sunday only—	
Leaves Trail	11:00 a. m.
Arrives at Rossland	11:45 a. m.

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For freight rates and further particulars, write to F. P. GUTELIUS, Gen'l Supt. Rossland, B. C.