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ELECTRIC MINING IN THE ROCKY MOUNTAIN REGION

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The largest electric hoist in the world is on the Free Silver shaft at Aspen, Colorado. It is an over-balanced double reel, flat rope hoist, equipped with a 200-Kw. 4-pole motor, capable of developing 120 H. P. continuously and 150 to 175 H. P. intermittently. An auxiliary 60-H. P. motor, ordinarily doing other work, is arranged so that it can be geared to the hoist counter-shaft and assist the large motor if neccessary. Each reel has 1500 feet of 4 by ⅜-inch flat rope, weighing 6¼ pounds per foot. The cage weighs 1375 pounds, bucket and ore (hung from cage in sinking) about 2400 pounds, car and ore about 3500 pounds, and bailer, containing 111 cubic feet of water, about 9000 pounds. Two counter-weights are used, one for the cage and another for car, the two being combined when bailing. Two armature pinions are provided (the motor sliding on rails), one for ordinary hoisting giving a speed of 800 feet per minute, and the other for bailing at 1000 feet per minute, which, with a maximum load of about 10,000 pounds (bailing), would require over 300 H. P. net, exclusive of friction in gearing and rope, were it not for the over-balanced arrangement. Actual tests have shown that the average current consumed in hoisting with counter-weight is only about one-third of the amount required when the hoist is unbalanced.

Pumps.—The electric pump presents a somewhat more difficult mechanical problem than the hoist, on account of conversion of rotary into reciprocating motion, and importance, in most cases, of compactness and protection of the motor against water. That the problem has been satisfactorily solved, however, is proved by the large number of electric pumps of various kinds and sizes in successful operation.

Duplex and triplex pumps, both vertical and horizontal, are suitable for operation by electric motors. For small pumps, where plenty of space is available, a belted motor affords the cheapest arrangement and gives satisfactory results. In the majority of cases a geared pump with motor on the same base is best. Both spur and worm gears have been used successfully, various devices being employed with the latter to neutralize the thrust. In the Virginius 70-H. P. pump, the armature shaft carries two worms, one right and one left-hand, working into two gears which mesh into each other. In the 15-H. P. pump in the same mine, the armature is placed vertically, and its weight approximately offsets the thrust. In most of the electric pumps made during the past few years, spur gearing has been used, and with good results.

The sinking pump is the most difficult to design, on account of the small space available for the motor, and the necessity of enclosing it in a practically water-tight case; but numerous successful pumps of this kind have been made and installed. The three-phase induction motor is specially adapted to this work, as it has no brushes or moving contacts, and the wires can be carried through water-tight bushings in the case to the stationary terminals on the field.

Speed control is an important question in electric pumping. Where waste of power is unobjectionable, a rheostat in armature circuit is suitable. If high efficiency is imperative, and the required variation in speed is not great, it may be economically accomplished by varying the field strength of the motor, either by commutating a sectional field or by use of a rheostat. When the generator supplies nothing but the pump, an excellent method is to vary the generator voltage by changing its speed or field strength, or both. In some cases a water by-pass can be advantageously used. In others it is best to pump at full capacity intermittently. The most suitable method is a matter of judgment in each case.

Blowers.—The running of blowers and exhausters is another simple operation, the motor being either belted, geared or direct connected to the blower shaft. Small outfits of this kind, placed at various points throughout the mine, run continuously with very little attention, and afford the most economical and satisfactory ventilation—far superior to the vitiated air that has passed through air-compressors and drills.

Percussion Drills.—To obtain with electricity the rapid reciprocating motion with varying stroke and necessary elasticity required in a percussion-drill, and at the same time get a machine that will stand unlimited abuse, has been the hardest problem in the mining field that the electrician has had to solve.

Two general methods have been followed. One employs the ordinary rotary motor, connected to the drill by a flexible shaft and producing the oscillatory motion by cranks, cams, levers, springs and similar devices. The other uses the solenoid principle, the plunger being moved back and forth within two solenoids, placed end to end, by currents sent through the two alternately, these currents being shifted automatically at the drill or generator—generally and preferably at the latter.

The solenoid type of drill is the only one that has been used commercially and successfully In this country. These drills were tried in several mines in Colorado and elsewhere about four years ago, but were only partially satisfactory. The principal defects were lack of pulling power, heating of solenoids, unsoldering of connections and breaking of drill chucks, due to the crystallization of the bronze of which they were at that time made. These defects have been remedied by better electrical and mechanical design of solenoids and connections, and the adoption of an all-steel plunger and chuck. The improved drills have been used successfully for some time in quarrying and tunneling in