secondary lines, but is not concerned with the high-tension lines or power plants of the power company. A reasonable rate for power, arranged between a willing purchaser and a willing seller—a contract, in fact, which each party knows the other will respect—is the basis and the real reason for that great railway electrification. Neither party questions the other's integrity or financial soundness. One delivers the power it has undertaken to supply and the other uses it. The arrangement is ideal in its simplicity and entirely satisfactory to everybody concerned. It will, in my opinion, be necessary to have such attractive power-supply situations as those outlined above, backed by abundant supplies of power, in order to foster and encourage early railway electrification work in this country.

Railway electrification is, in my opinion, a very pressing financial, economic and engineering problem—a problem worthy of the best attention of the most highly trained and experienced specialists.

THE AIR-LIFT PUMPING SYSTEM

By A. W. Swan
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TWENTY-FIVE years ago Dr. Julius Pohlé made his first successful experiments on pumping from deep wells, using compressed air, and the air-lift system as it is to-day is, with the exception of detail in design, the same as the Pohlé. Contrary to what one might expect, the compressed air is not used to force the water upward; air is led downward in the well and released in the rising main. Here the compressed air mixes thoroughly with the water and forms a froth, which, being lighter than the body of water in the surrounding rock, is naturally forced upward. All that is necessary for an air-lift system is an air compressor—which is housed, of course, in an engine room which may be any convenient distance from the well, an air pipe and a delivery pipe. It is evident that the air-lift system is simplicity itself—and it has other advantages.

In city water supply the problem of filtration is acute; slow sand filtration is expensive to instal and maintain, and at the best does not absolutely sterilize the water, and for complete sterilization the unpleasant chlorine process or the expensive ozone or ultra-violet ray process must be installed. It is well known that aeration of water has a strong sterilizing effect, and the city of New York has installed special aerating ponds as part of the Catskill project. Now, in the air-lift system aeration is entirely automatic, and as the water and air flow upward impurities are thrown off. That this is no mere claim is shown by the case of the Asbury, N.J., waterworks, where the air-lift rendered iron-impregnated water as clear as spring water.

Although the principle of the air-lift system is simple, it does not follow that careful design is not necessary. In the earlier Pohlé pumps the air was admitted to the water pipe by a simple bend in the air pipe. However, it was discovered that the chief cause of loss of efficiency in the air lift was air-bubble slippage; the larger the bubbles the greater the loss in efficiency. Hence, design tended to the improvement of the mixing chamber, and in the standard air-lift pumps of the present day, this mixing chamber is carefully designed to divide the air into very fine streams, thus preventing the formation of large bubbles.

Owing to the fact that in the well proper there are only the two pipes, for air and water, the capacity of flow is limited only by the capacity of the well, and as there are no moving parts in the well, wear and depreciation are almost negligible where they would be greatest with the plunger type of pump. Further, one compressor can be used to supply the air for several wells, and the flow of water is regulated from the power house by controlling the air pressure. Among other advantages of the air-lift system may be mentioned the fact that sand or gravel have no effect on the operation of the pump, being simply carried along with the air and water and deposited at the top of the well. The scouring action of the pump in removing sand or gravel generally increases the flow by widening the area from which water is drawn.

In respect to economy, this varies with the size of installation and submergence. Larger installations are, of course, more economical, and for a flow over 300 gallons a minute the air-lift pump will usually be less expensive than the plunger type. In the case of smaller pumps, the actual cost will be about the same for the two types, provided there is sufficient submergence for the air-lift pump. By submergence is meant the ratio of the depth of the mixing chamber below the pumping water-level to the total height pumped. The air-lift is not advisable where the submergence is below 35 per cent., and the best condition for this type of pump is from 45 per cent. to 60 per cent. submergence. The actual cost runs from 1¼ to 2 cents per thousand gallons pumped. The air pressure necessary to run an air-lift pumping system is steady once the water has started to flow, but some provision should be made for extra pressure to start the pump. According to Kent, the compressor should provide one cubic foot of air for each gallon and a half pumped, but this will vary with the depth of the well. Kent also gives the formula $A = \frac{LC}{16,824}$ where A = cubic feet of air, L = lift, C = cubic feet of water pumped.

The air-lift is not very well adapted to pumping horizontally, owing to the fact that the air tends to separate from the water and collect along the top of the pipe. Hence, where water is to be pumped from the top of the well a "booster" is used. This consists simply of a tank in which the air is separated from the water, the pressure of the air being used to pump the water on the rest of its journey by displacement.

In addition to pumping water, the air-lift has a wide field of application for pumping acids, brine, pulp, etc. In ore-leaching, the air-lift has been used to great advantage, and in some of the western oil fields oil has been pumped by this method from wells 800 feet deep.

The February statement of Southern Canada Power Company, Limited, gives gross of $39,326, an increase of $6,368, and net of $18,235, an increase of $3,382. For the month of the current fiscal year gross earnings at $194,860 are $41,518 higher than in the previous year, and net at $88,103 are $11,284 higher

During the first half of last year 289,000 tons of steel were produced in Japan exclusive of her colonies. The largest producer was the Government Steel Works, with 200,000 tons. The Japan Steel Tube Company came next with 22,000 tons, and the Japan Steel Works with 14,000 tons, while the two smallest producers, the Kawasaki Dockyard Company and the Kamaishi Steel Works, turned out 12,000 and 10,000 tons respectively. It is estimated that the year's output of those mills will reach at least 570,000 tons, an increase of 50 per cent. over 1916.