

the air lift pump the transmission loss is much smaller and as no attendance at the well is required, they may be put in operation or controlled by a valve in the power house.

Not Affected by High Temperatures.—Fluids of different densities and temperatures may be handled to advantage by the air lift in cases where the use of other types of pumps would be prohibited. In the case of a hot liquid the air absorbs part of the heat of the liquid and hence is increased in volume, so that the discharge of liquid for the same expenditure of free air is greater with hot than with cold liquids. This results in a considerable gain in efficiency for the pump.

Aeration.—Where the water is to be used for a domestic supply and there are impurities in it such as iron, it has been noticed that the iron is oxidized by the aeration of the water and the supply is thereby improved. Aeration is especially advantageous in the pumping of sewage on account of the aid it gives in the oxidation of the impurities.

Reliability.—Air lift pumps are not liable to sudden stoppages or breakdowns.

The Wisconsin experiments were not made on actual wells, but the apparatus was designed to reproduce as nearly as possible the practical working conditions of the air lift pump.

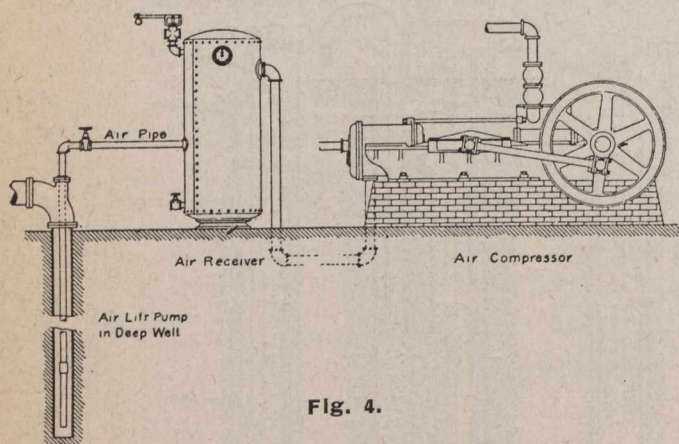


Fig. 4.

The experiments made by the writers were planned to determine, first, the effect on the discharge and efficiency of variations in the working conditions of the air lift pump, such as variations in submergence, lift and quantity of air used, and second, the effect on the discharge and efficiency of changes in the structural features of the pump. The bulletin contains the complete log of the experiments, arranged in tables and diagrams. The coefficients which were evaluated and applied to Lorenz's theory of the air lift are given. The conclusions reached by Messrs. Davis and Weidner are as follows:

Conclusions.—A comparison of the advantages and disadvantages of the air lift pump shows that there is a field of usefulness of sufficient magnitude to make it an important apparatus deserving of further theoretical and experimental study. From a study of the discussion and accompanying data given in the bulletin, ideas in regard to improvement in the design will no doubt be suggested to the designer or experimenter. However, a full realization of the complexity of the action must be appreciated, as also the number of variables which enter into the problem. In order to facilitate the study of results, the variables which may affect a particular type and size of pump are again given at this place. They are (1) percentage of submergence, (2) lift, (3) discharge, (4) volume of air, (5) pressure of air. The conclusions which may justifiably be deduced from the Wisconsin experiments are given below, and hold only for the particular type, size and length of pump on which the

experiments were performed. The inference, however, may be drawn that these conclusions would hold for other types and sizes.

(1) The central air tube pump has the greatest theoretical capacity for a given size of well.

(2) The coefficient of pipe friction and slip decreases as the discharge increases, and decreases as the ratio of volume of air to volume of water increases.

(3) The coefficient of pipe friction and slip varies with the length of pump, but seems to be independent of the percentage of submergence and of the lift.

(4) The length of pump, the percentage of submergence, and therefore, the lift remaining constant, there is a definite quantity of air causing the maximum discharge. This quantity of air for maximum discharge, as also the ratio of volume of air to volume of water, differs for different percentages of submergence and lift, the length of the pump remaining constant.

(5) The length of pump remaining constant, the maximum output (e.g., foot gallons) occurs at about the same percentage of submergence for all rates of air consumption, being at from 61 to 65 per cent. for the pump used in the Wisconsin experiments. At other submergences the output varies as the ordinates of a parabola having vertical axis. Under these conditions the lift does not remain constant as the percentage of submergence varies.

(6) The length of pump and percentage of submergence remaining constant, and therefore constant lift, the efficiency increases as the input decreases; that is, the highest efficiencies are obtained at the lowest rates of pumping.

(7) By varying the percentage of submergence, and therefore the lift, the length of pump remaining constant, the maximum efficiency is obtained at approximately 63 per cent. submergence for all rates of input or discharge.

(8) The lift remaining constant, the efficiency increases as the percentage of submergence increases, for all rates of input and all practical percentage of submergence.

(9) With the same size and type of pump the percentage of submergence remaining constant, the efficiency increased as the lift increased for the small lifts experimented on; that is, up to about 24 ft. From a theoretical study, however, the indications are that a point will be reached from which the efficiency will decrease as the lift increases.

(10) Other conditions remaining constant, there is no advantage to be gained by introducing compressed air above the surface of the water in the well.

(11) The type of the foot-piece has very little effect on the efficiency of the pump, so long as the air is introduced in an efficient manner and the full cross sectional area of the education pipe is realized for the passage of the liquid. Anything in the shape of a nozzle to increase the kinetic energy of the air is detrimental.

(12) A diverging outlet which will conserve the kinetic energy of the velocity head increases the efficiency.

THE TRANS-AUSTRALIAN RAILWAY.

Full plans and complete specifications for the construction of the railway between Port Augusta in South Australia and Kalgoorlie in Western Australia have been prepared by the engineers of the Commonwealth government. The delay in making the plans available is said to be caused by important questions of policy—such as the gauge to be decided upon and the wages to be paid to laborers. It is understood that the construction will be carried on by day labor, but parts of the work may be done by contractors.