AIR LIFT PUMPING*

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IF I had been called upon to write this paper some 12 or 15 years ago, I could have conscientiously and honestly told you many things that I then believed, which time has proven might not always be the case, in regard to air lifts. In that early day of air lift pumping first entering into the commercial field, there were a great many conditions surrounding its operation that were unknown to the manufacturers of the lifts themselves.

It has been charged by many, and more especially by engineers, that the manufacturers of air lift pumps wish to surround their product with mystery. I can truly say that this is not the case. The manufacturers of air lift pumps, like any other trades-people, wish to sell all of their product that they can, and will willingly give all the information regarding its operation that will make it more popular in the deep-well pumping field. However, they are limited in this desire from the fact that no *master formula* has as yet been devised whereby infallible rules may be laid down for the proper designing of any and all installations, without any regard for the conditions that exist in the wells.

The Individuality of Wells

Some 15 years of experience have taught me that in many instances wells are just as individual in their actions as are persons. Therefore, a properly designed air lift installation, operating satisfactorily in one well, might give entirely different results when installed in another well which, to an inexperienced operator, might seem to be identical.

While experience is not absolutely essential to the pumping of water from deep wells by the means of compressed air, yet I know of no engineering field where experience counts for more or is more essential than in air lift pumping.

Some of our best engineers have branded air lift pumping as a system sadly lacking in economy, but in such cases their judgment has been based upon results obtained from improper methods of piping, in connection with inefficient air compressors. Many have also become convinced that there is no special merit in the patented air lift pumps, that home-made devices will answer the purpose just as well. However, in all my years of experience, I have never yet seen one of these home-made lifts over which a patented pump would not give excellent returns on the small amount of money invested in it.

Contrary to a popular belief, the compressed air discharged through an air lift pump does not blow the column of water upward after the first discharge. When the static head is lifted from the working head of the well by the first inrush of air, the water is forced out of the pipe in a solid column. After that, the compressed air passing through the pump reduces the specific gravity of the water in the discharge line of the pump. This consequently moves upward by the expansion of the air bubbles, aided by the greater weight of the solid column of water surrounding the discharge line.

Should Avoid Large Bubbles

In an economically designed air pump, it is imperative that the formation of large bubbles of air be avoided, for these have a tendency to rush upward without lifting the proper amount of water for the stored energy that they contain. Therefore, the pump should divide the air into small streams or jets, creating as many small bubbles as possible in order to give the best economy. The slip of these bubbles constitutes the chief loss in the energy of the air lift. It is figured that this varies as the square root of the volume of the bubbles. Therefore, the smaller the bubbles, the more efficient the air lift.

Of course, one of the foremost things to be considered in the installing of a pumping plant is its efficiency. I presume there is no one word in the English language to-day that is used more in manufacturing and engineering circles than the word efficiency. It is a good strong word, but may be figured from so many different bases of calculation that all conditions in connection with the apparatus must be thoroughly understood before the percentage of efficiency that is claimed for it can be valued. The only true way I know to figure the efficiency of a pumping plant is that at the end of the year the column in the ledger headed "operating costs" be added up and the results calculated from its total. In this column we will also find, if we note down the items such as repairs, break-downs and their attendant losses, and read between the lines the worries that were caused thereby, we can also determine just how efficiently the system has or has not caused trouble.

Workable Efficiency Required

In travelling over the country I find that water works superintendents and manufacturers are more and more demanding workable commercial efficiency from their pumping machinery. They realize that by installing some very closely adjusted high-speed apparatus in their wells, they may be able during its short life to pump water very cheaply per thousand gallons, but that in about nine cases out of every ten, such a pump is sure to cause trouble sooner or later, more often sooner; and that the small amount saved per thousand gallons pumped during the course of the pump's successful operation, is far more than offset by repairs, shut-downs and pulling of wells.

To give some idea of the faith that the underwriters of the country have in the reliability of the air lift system, I will, with Mr. Judd's permission, tell his experience with them in reference to his discarding of deep well pumps and the installing of air lift systems in the city wells here in Mason City. The Board of Underwriters in Chicago granted him 30 points on the key rate of insurance for the fire protection the increased yield of the wells would afford the city, and they gave him 130 points because of the reliability of an air lift pumping system. This is something that should be weighed very carefully, for if there is any institution in the wide world that figures from exact statistics, it is the underwriters. They do not guess, they know.

As I said before, no one has yet been able to figure a master formula for the installation of the air lift any more than has some noted doctor been able to write a master prescription that will cure all diseases to which flesh is heir. However, the manufacturers of air lift pumps have at quite a great expense gathered data from laboratory tests and field experience that enable them to construct formulas which cannot be universally applied to all conditions, yet can define and introduce certain rules which enable them to calculate the requirements for a proposition when the exact data are known.

Exact Data Sometimes Lacking

When exact data are lacking, conditions are usually *assumed* and a lift installed. Then, from results obtained, the engineer, by basing his judgment on experience, can proceed to pipe up the well so as to get economical results. To give an illustration of this:—

Some years ago I installed an air lift in a flowing well on a ranch in southwest Texas. The well was 8 ins. in diameter, about 600 ft. deep and flowed about 20 gals. per min. The owner of the ranch had only a small compressor, its maximum capacity being 30 cu. ft. of compressed air per minute. A 6-in. pump was installed 2 ft. in the well, and this 30 ft. of air delivered to it. The head of the well dropped 20 ft. from the surface and the well yielded 530 g.p.m., accurately measured over a knife-edged weir. Of course, this was phenomenal. Never before or since have I seen such a small volume of air deliver so much water from a deep well.

Only the week before last, at Fort Dodge, Iowa, we installed a 6-in. pump in a flowing well located on an island in the Des Moines river. The well was 8 ins. in diameter, 500 ft. deep and flowed 21 gals. per min. The same size pump was located 200 ft. from the surface, and we delivered to it 200 cu. ft. of air. The working head of the well dropped 150 ft. from the surface and yielded 80 g.p.m. This proved

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