

## The History of Deep Well Turbine Pump

### 深井透平抽水機之歷史

方 根 壽 *Ken-shou Fang*

A deep well turbine pump is a special form of centrifugal pump. Its creation is the result of a farmer's quest of the underground water for irrigation. At the beginning a conventional horizontal centrifugal pump was used to pump out water from the underground. Later, as water level receded, it became necessary to dig a pit (Fig. 1) in order to keep the water within the suction limit of a pump. As we look back, this "pit" idea was rather awkward, their troubles were numerous: it was costly to dig; it was difficult to keep rain water out and to keep the cattle from falling in, and finally it was impossible to deepen the pit in order to catch up the ever receding water level. Therefore, the pit soon disappeared and was replaced by various ingenious devices by human beings.

A search of record confirms the established fact that the birthplace of the deep well turbine pump is nowhere else but the arid and fertile land of Southern California of the U. S. A. Even today Southern California is still the center of this industry.

At this point some of the farmers turned their pump vertically with extended shaft and base plate. The engineering problem in this arrangement is on the coupling between the motor and the pump. Many ingenious couplings had been developed to cope with multiple functional requirements: carrying the weight, alignment and impeller adjustment. This of course was a kind of hasty arrangement. It did not go very far before it was abandoned. The deep well reciprocating pump had been in use for many years, but its low capacity could not satisfy the farmer's need. This kind of pump also was soon abandoned in favor of deep well turbine pump.

In 1897 P. K. Wood of Los Angeles built a vertical pump which can be said to be the forerunner of present day deep well turbine pump, even though its construction was far different.

This Wood pump consisted of a series of propellers. The lineshaft bearings were square bronze castings with a hole drilled through the center to support the shaft. Onto four sides were bolted steel wings which fit into well casing; the column was thus not needed. There was one propeller on each side of bronze bearing. One of the propellers was set-screwed to the shaft, all of the others were threaded and added as a coupling for the shafts. The shaft extended through a cast iron base at the ground and was driven by a vertical pulley.

The pump as described above was very crude and its efficiency was very low. However, it took some courage to produce such an innovation, and Mr. Wood deserves the title of "father of the deep well turbine pump."

In 1901 Byron Jackson built the first turbine pump at Woodland, California. It was sold to Pabst Brewing Company of Milwaukee, Wisconsin. This could be the first practical turbine pump produced. Today Byron Jackson, Inc., with headquarters at Los Angeles, is one of the major pump manufacturers in the nation. At about the same

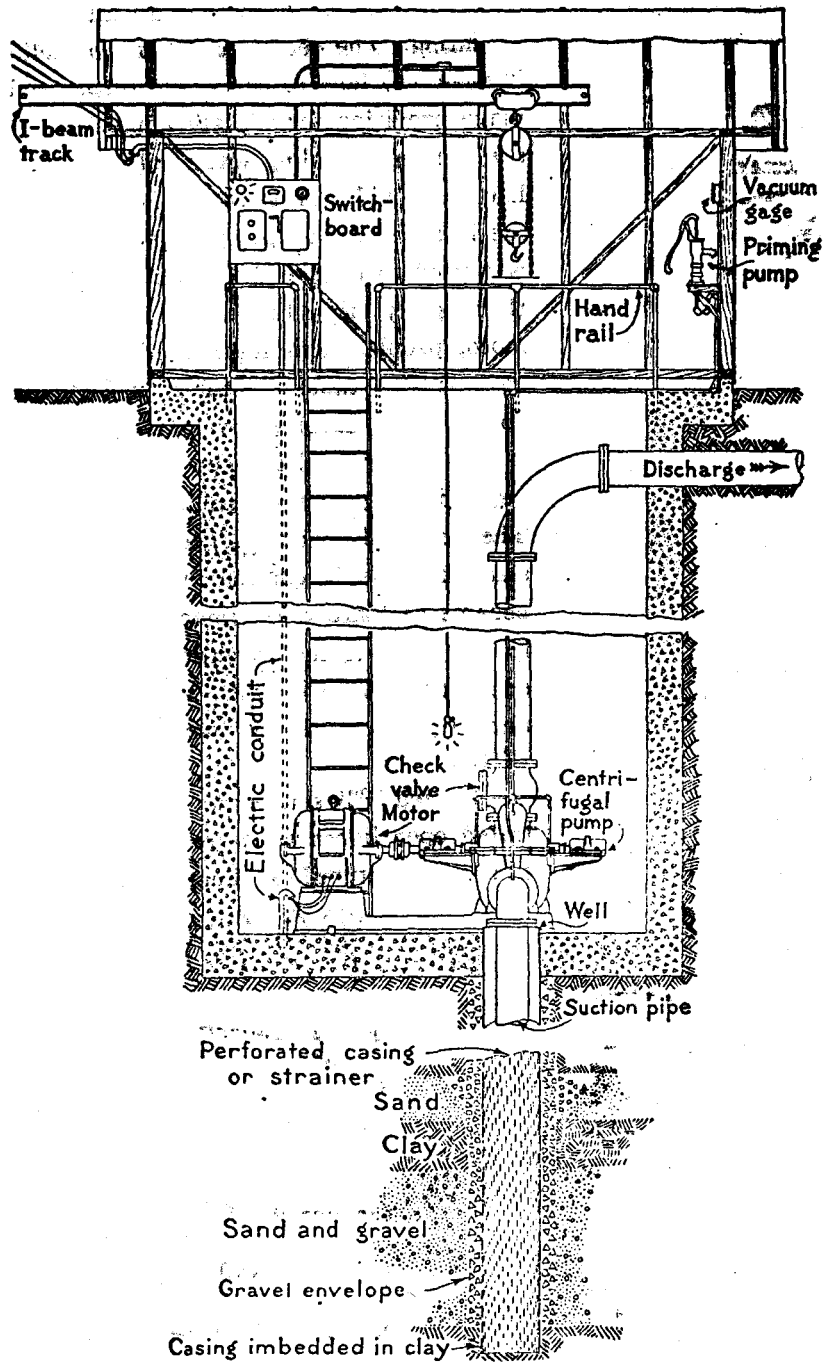


Fig. 1. Pump installed in a pit (From USDA Farmer's Bulletin 1857)

time (1904) Mahlon Layne started manufacturing pumps at Houston, Texas. This was the beginning of Layne & Bowler Inc. of Memphis and Layne & Bowler Pump Company of Los Angeles.

In association with the development of deep well turbine pump is the progress in the motor design. Horizontal motor was first used to drive the vertical pump through

a quarter-turn belt. (Fig. 2) Later, around 1916, the motor was modified for vertical

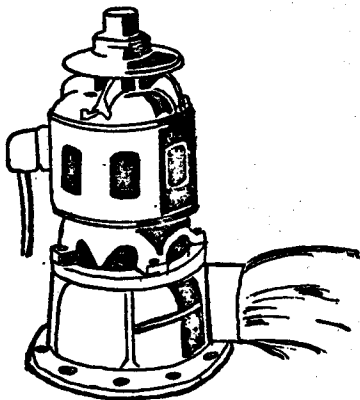
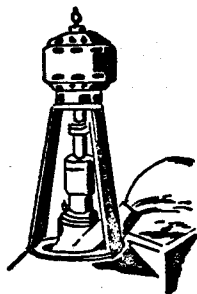
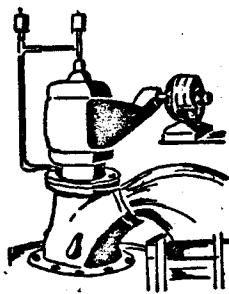


Fig. 2. Progress in motor design  
1908, Horizontal motor with  
quarter-turn belt was first  
used to drive a deep well  
turbine pump.  
1916, Vertical solid shaft  
motor with thrust stand.  
1922. Vertical hollow shaft  
motor was invented.  
(From U. S. Motor)

mounting. The design problems for solid shaft motor involve (a) how to carry the thrust and (b) how to make provision for adjusting impeller. When expensive flexible coupling was used, pump manufacturers had to provide thrust stand and impeller adjustment mechanism on the pump side. When solid coupling was used to couple the motor and pump shafts together rigidly, then the burden was passed on to the motor people. This latter method gave simple arrangement and thusly motor manufacturers became involved in the turbine development.

As water level receded further, the pump had to develop a higher head, and high axial thrust resulted. The thrust bearing had to be larger so the motor shaft became larger than the pump shaft. It finally became so large that someone drilled a hole through it. This led to the invention of the vertical hollow shaft motor in 1922 with which the impeller adjustment is done easily by turning a nut on the top end. (Fig. 3)

Around 1924 semi-open impeller and water lubricated open lineshafts were introduced by I. A. Oliver and manufactured at Pomona Pump Company, Po-

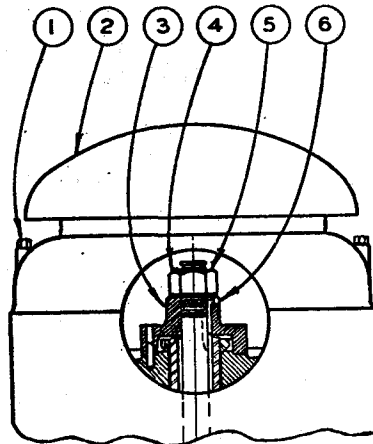


Fig. 3. Vertical hollow shaft motor  
Item (5) is adjusting nut

mona, California. They at one time were very successful in turbine business and made other manufacturers adapt their features while they, until the company was sold to Fairbanks, Morse & Company in 1944, never made any enclosed impeller nor enclosed shafts. 頁下接36