# Operation of Deep Set Shaft-Driven Water Supply Pumps

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## INTRODUCTION

The interest in suitable deep set shaft driven pumps for water supply has increased because of high repair costs of submersible pumps and of an abundance, usually, of low cost fuel for power internal combusion engines.

Too often, in the past, pump selection and well construction has been determined by the lowest initial cost rather than by the evaluation of long range costs. This paper will try to cover, by going to basic mechanical design, some of the well construction and pump selection methods that should keep to a minimum pump failures.

The well construction is of prime importance. To avoid "dog legs" in the well a suitable directional survey should be made; one should remember that the water well is cased with metal casing, for this fact destroys the effectiveness of some surveys. Furthermore, to protect the pumping equipment from sand or other abrasives, correct gravel packing of water bearing formations are very important (Figs. 1, 2 and 3).

A sample of the fluid should be sent to a qualified laboratory for material and/or coating for corrosion control. The temperature of the fluid should also be noted, because operating temperature of the fluid will have a singular effect on several factors: material selection for corrosion control, bearing clearances, etc. In a well pump of tube enclosed shaft construction, the difference in thermal expansion between column pipe and the line shaft may require excessive end play or lateral in the bowl unit when pumping hot fluid.

The basic mechanical design of the vertical turbine pump consists of four elements of construction: the driver, discharge head assembly, column and shaft assembly, and bowl assembly. The size and configuration of these separate elements can be changed to fit the well requirements. However, it is important that the system designer understand the functions of each particular element so he can best take advantage of the flexibility of design.

## DRIVER

The function of the driver is to provide the power to drive the pumping element and support the unbalanced hydraulic thrust contained in the pump itself. The drives utilized are vertical "hollo shaft" electric motors or right angle gear drives to be used with internal combustion

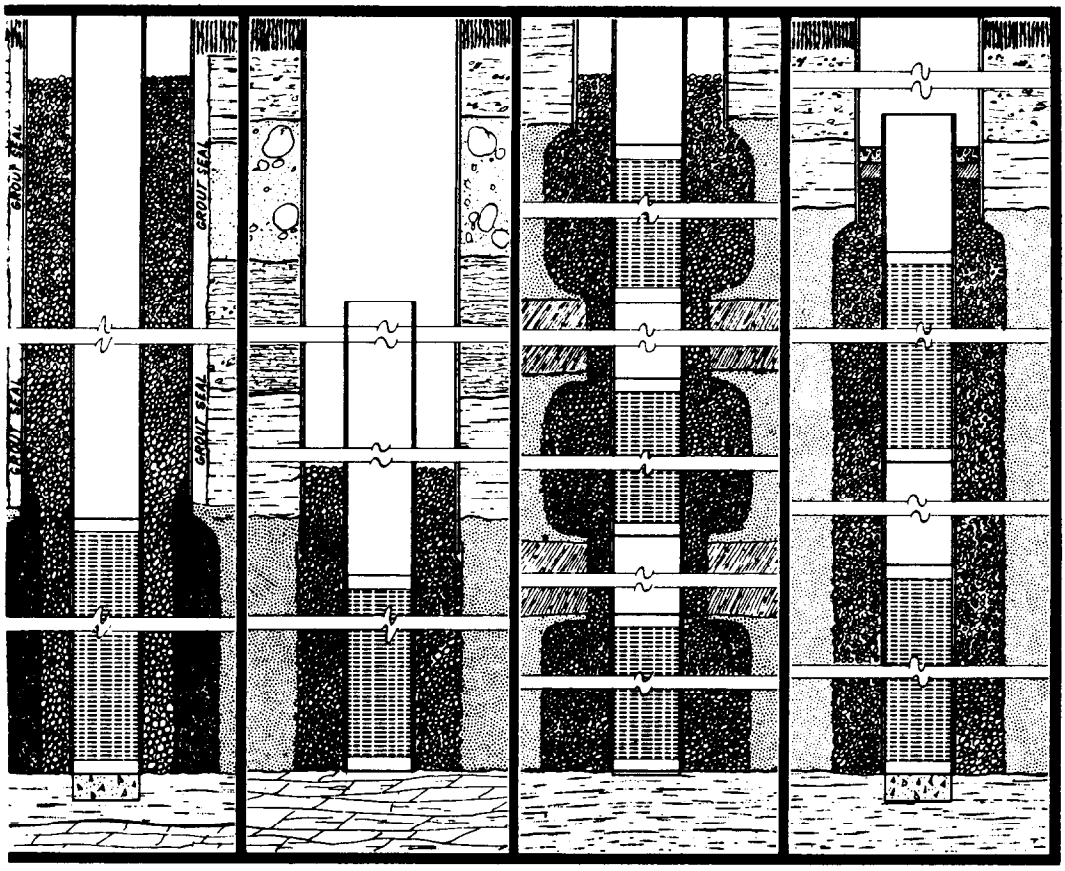



Fig. 1

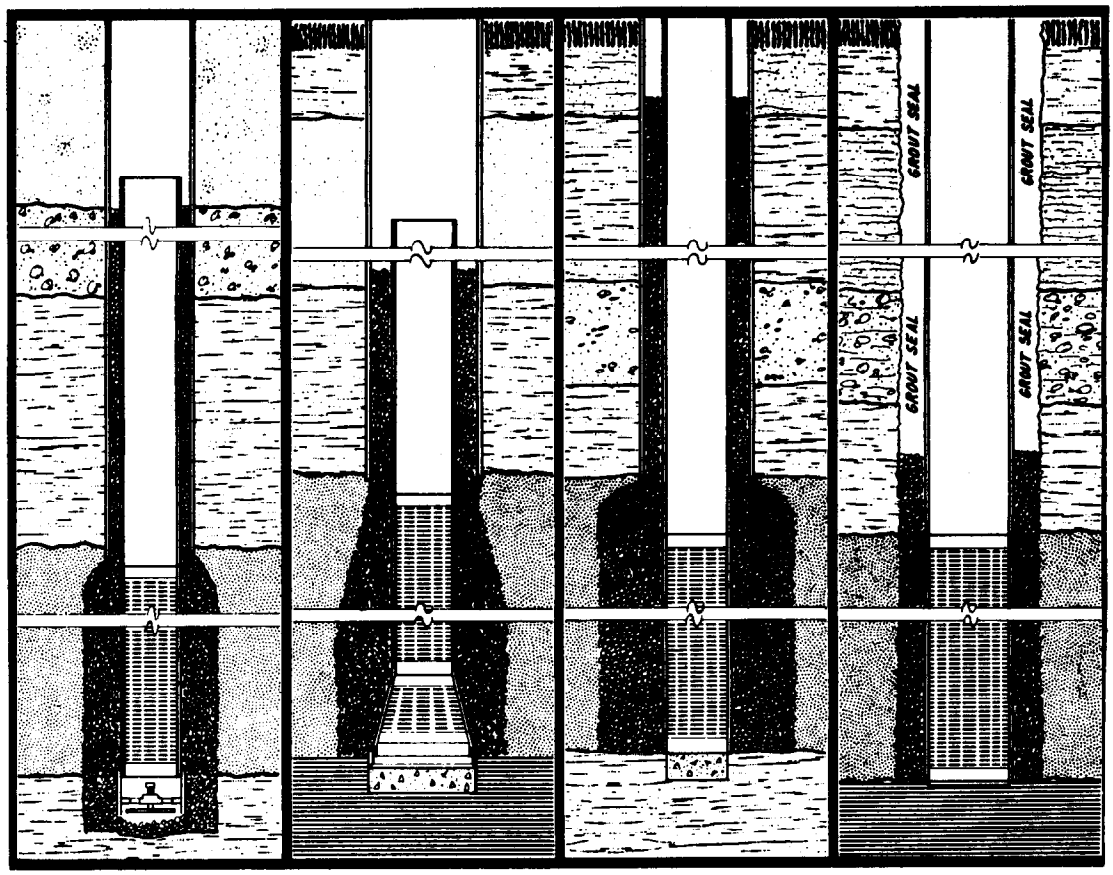



Fig. 2

engines. To obtain the horsepower required one converts BPD to GPM by multiplying BPD x .02917.

Use TDH x GPM / 3960 x bowl efficiency = LAB HP + Line Shaft loss + Thrust bearing losses = HP

To obtain thrust: Constant thrust factor of bowl unit x TDH+ Line Shaft and Impeller Weight.

## DISCHARGE HEAD

The discharge head assembly is supplied in a number of configurations. The simplest of these designs consists of a cast iron discharge head which aligns the pump with the driver; and, bo so doing, it eliminates the need of any shaft flexible coupling device. It also supports the driver in a vertical position. From the discharge head are suspended the column and shaft assembly and the bowl assembly. The external support for the whole pumping system is obtained through the structural support at the discharge head which also serves the function of turning the flow of fluid from a vertical direction to a horizontal direction. It provides a seal by use of a stuffing box or mechanical seal where the shaft passes from the flow stream surrounding atmosphere. To obtain the total weight supported by discharge head:

Total weight of Column and Shaft Assembly + Hydraulic Thrust + Weight of Bowl Assembly.

## COLUMN AND SHAFT ASSEMBLY

The column and shaft assembly is designed to separate the bowl assembly from the discharge head. The column pipe performs two functions: it carries the actual weight of the suspended bowl assembly; and it also provides a means of conducting the fluid vertically from the pumping element to the discharge head.

The shaft is used to transmit the power from the driver to the bowl assembly to make it operative for pumping.

The length of this column and shaft assembly can be varied to accommodate any required separation between the bowl assembly and the discharge head desired by the system designer. To select the proper length one must know the BPD or GPM, TDH or total heads, and setting depth of pump.

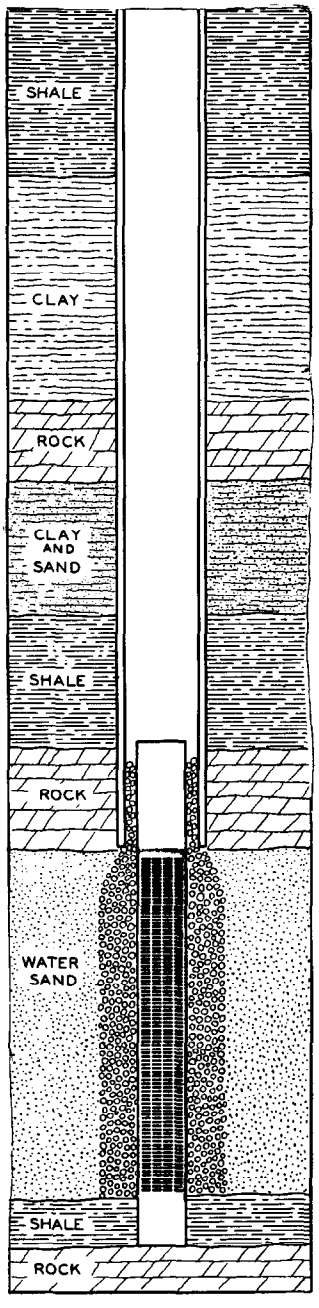
## BOWL ASSEMBLY

The bowl assembly is constructed of basically standard design from the line of equipment manufactured by the pump manufacturer. The diameter and length or number of stages can be changed to suit the system designer's requirements within bowl limit. For selection, the following information is needed: total heads; gallons per minute or barrels per day; data on and specific gravity of fluid; diameter of well casing.

## SUMMARY

The important factors to determine before one can select a pump are:

(1) Inside diameter of well
(2) Depth of Well
(3) Gallons per minute or barrels per day to be pumped
(4) Analysis and specific gravity of fluid



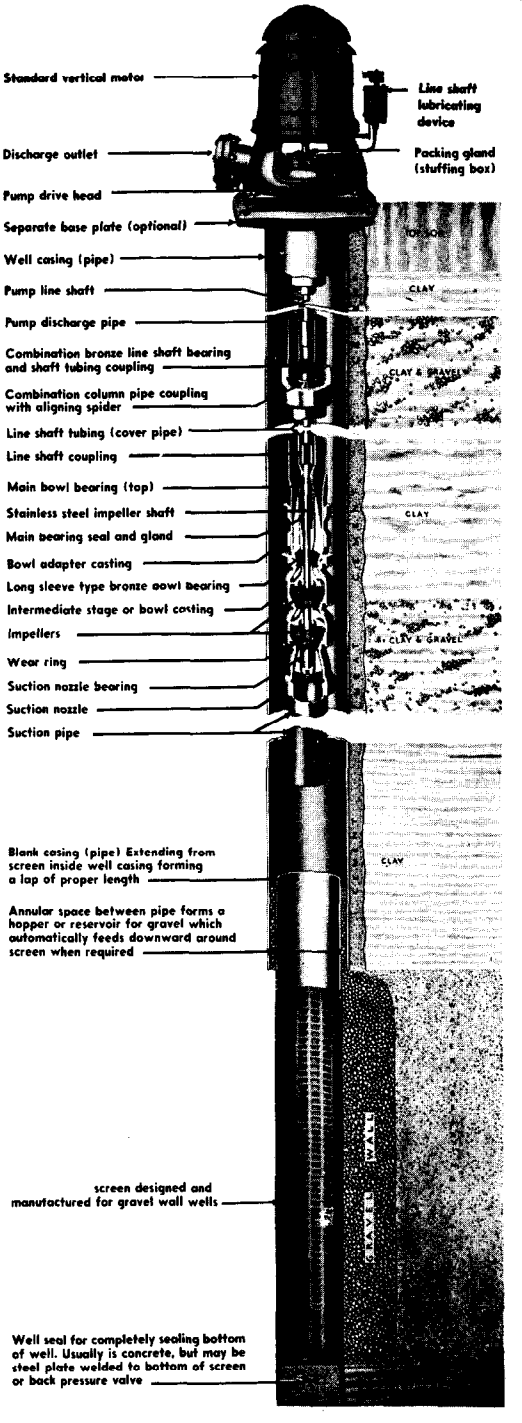




Fig. 3

(5) Type of power which will be used to drive the pump and the speed at which the pump will operate. (If electricity is to be used, the voltage, cycles and number of phases must be taken into consideration. If pump is to be driven by internal combustion engine, the speed at which the engine is to be operated must be known to select the correct gear ratio for the right angle gear drive.)
(6) Static water level
(7) Drawdown
(8) The well lift, which is the sum of static water level and the drawdown
(9) The above ground head, or the height above the surface of the ground to the point of discharge plus friction in the discharge pipe and fitting, or the pressure against which the water is pumped.
(10) Installation below ground surface of the pump setting or depth pump bowls