

RESEARCH ARTICLE

DEVELOPMENT OF A TURBINE SYSTEM TO EXTRACTION DEEP UNDERGROUNDWATER.

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Manuscript Info

Abstract

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*Keywords:*rain, underground water, desert land, pumps, electric motors. Due to the recent lack of rainfall, the undergroundwater level has dropped significantly, especially in the desert lands. Therefore, it is necessary to use multi-stage turbo pumps, but these pumps need high power to be used when using deep wells, due to friction losses and losses resulting from the use of rotary bearing and shafts. These pumps are typically operated by electric motors. Which necessitates the presence of a source of electrical energy near the well, which is often not found in desert land.

The present study investigates the pumps used to extract underground water from the deep artesian wells that have been used. recently due to the decline of the undergroundwater level resulting from the drought. The aim of the study was to develop these pumps in order to improve their performance and increase their efficiency, and thus reduce the energy required to operate these pumps. Where a hydraulic system was used to operate the pump and, dispense with the electric motors, as well as dispensing the rotary shafts and bearings, thus reducing the energy required to operate the pump.

A practical study was carried out on a turbine pump with a well-known electric motor specification installed on an artesian well after the depth of the well and the level of the water surface were measured in the well. When the turbine pump was operated, the data required for the study was taken, then a developed theoretical model of the turbine pump hydraulics and under the same external conditions of the well. The specifications of the new model developed using the theoretical equations were calculated. When comparing the results obtained for the turbine pump that was installed and operated on the well with the results obtained for the theoretical model. The developer needs much less energy to run it to get the same discharge.

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Introduction:-

The multi-stage turbo pumps are one of the most important means used to extract underground water from deep artesian wells. Due to the lack of rainfall in general in the past years, the level of undergroundwater levels in artesian wells has reached deep distances away from the surface level, Water cannot be pumped by rotary pumps. As multi-stage turbo pumps have the potential to extract water from deep artesian wells and discharge, the principle of operation is similar to the principle of working with pumps but contains more than a helicopter's defenses placed

operation is similar to the principle of working with pumps but contains more than a helicopter's defenses placed close to each of them on a vertical column and the discharge of the pump depends on the diameter of the pump and

Corresponding Author:-Waleed abdulhadi ethbayah. Address:-Specialist Trainer c, High institute of energy, Kuwait. the number of propellants [1] so it is common in areas where the level of groundwater away from the level of the surface of the earth and relied mainly on extraction Water used in agriculture and livestock, as well as used for drinking after treatment in areas where there is no surface water.

The modern technology always seeks to improve the efficiency of the systems used in all fields. As turbo pumps operated by electric motors consume a large amount of electrical energy. As the provision of electrical energy is one of the most important challenges in the present and future as well as the lack of electricity in most desert areas, Therefore, the design of the turbo pump has been developed to increase its efficiency so that the pump provides the same discharge using less energy, thus saving a large amount of energy and using a hydraulic system based on the hydraulic fluid In order to transfer the energy from the engine to the pump instead of the running shaft used with the electric motor in the model studied, the improvements in the pump included improvements in the design of the pump by removing some parts that consume additional energy and impede the passage of water through the drain pipe, In the new design model that resulted in these improvements increase the area of the water stream and reduce the energy required to run the pump and the same discharge without the need for the availability of electricity.

Experimental Work:-

The Turbo pump was Used:-

The study was carried out on a turbine pump (1). The pump consists of a three-phase electric motor. The engine capacity (22KW), which is placed vertically above the well, connects the electric motor with the running shaft. Figure 2 consists of a set of The pieces are the length of each piece of 1800 mm and diameter of 21 mm which are bound together at the ends by serrated joints. The shaft passes through the water pull tube and is centered inside and is fitted with 3 shape bearings placed inside the towing pipe at an equal distance of 1800 mm along the draw pipe The number of bearings shall be the number of parts of the running shaft used, each piece of the shaft between the electric motor from the upper side of the pump and the lower side of the tube clouds, which are inside the well below the water surface level. Table (1) shows the specifications of the pump used.



Figure 1:-The turbo pump is mounted on the well



Figure 2:-Turbo pump and shaft details



Figure 3:-Bearings used in the towing tube

Table 1:-Specifications of the pump installed on the well

The total	Power of the	Number of	Diameter	Number of	Discharge
pumphead(H) m	electric motorKW	running shafts	suction tube	Impellers	L/sec.
70-100	22	20	125 mm	9	10-15

Calculate pump discharge:-

The pump was installed on a 100 meter deep artesian well located in the district. The water level of the well was measured before the pump was operated. The pump was then operated and waited for a period of time until the water level was stabilized and measured, Then we started to measure the discharge of the pump where the pump pipe was pumped into a cube basin of known dimensions (4m * 2m * 2m). The flow was measured using a stopwatch to calculate the water height in the basin for a given time. Using the following equation:

$$Q = \frac{Vol.}{t}$$

Calculate the power of the electric motor:-

In order to measure the electrical energy consumed by the electric motor, the amount of voltages consumed was measured using a multi-measurement digital device (LCR-9073) and current measurement by PM (Philips). Using the readings obtained as the three-phase electric motor, the actual power consumed by the electric motor was calculated using the following equation [2]:

$$Pe = \sqrt{3} \ IVcos(\theta)$$

Calculate pump capacity:-

To calculate the power required to operate the pump, the following equation was used:

$$Pw = \frac{QH\gamma}{K_2\eta_p}$$

Where the discharge of the pump was measured in practice, and the total head of the pump was found using the Bernoulli equation [3]:

$$H = \frac{p}{\rho} + \frac{v^2}{2g} + Z + h_i$$

Where h_l represents head losses and is calculated from the equation:

$$h_i = h_f + h_{\min}$$

The h_f and h_{min} of the pipes and accessories used with the pipe can be calculated from the following equations:

$$h_f = f \frac{L}{d} \times \frac{v^2}{2g}$$

 h_{min} = Loss of head iv valves and fitting The amounts in these equations are calculated using tables prepared for this purpose[4].

The proposed theoretical model:-

The characteristics of the hydraulic fluid The ability to transfer a large amount of energy through small tubes and flexible hoses, and the basic characteristics of the hydraulic system The ability to shed power or torque multiplier very easily regardless of the distance between entry and exit, without the need for mechanical transmission gears, This is done by changing the flow of each pump between the pump and the engine in the hydraulic system. In the current theoretical model, the design of the turbine pump system will be changed to achieve higher efficiency, lower power consumption and the same discharge.

The electric motor will be dispensed with in the absence of electricity in most desert areas and replaced with a diesel engine placed on the ground near the well. The engine rotates a hydraulic pump as shown on figure 4.



Figure 4. Hydraulic pump used in the theoretical model

Which are economical (cheap), simple to install and reliable and are used to pump hydraulic fluid and high pressure, which connect to a closed tank containing hydraulic oil. Which is pulled from the shafts and driven through a special hydraulic transmission pipe designed to withstand high hydraulic pressure to the hydraulic engine that is attached directly to The turbo pump is from the bottom inside the well under the surface of the water which is rotated, which requires the use of hydraulic engine as shown in figure 5.



Figure 5.:-Hydraulic motor used in the theoretical model

This type of hydraulic engine is designed to deliver a great picture between price and performance by producing capacity at a reasonable cost, and these engines work well within a wide range of applications.

The oil tank is also able to contain an additional amount of oil in the event of an effusion, as well as when the oil shrinks and expands due to temperature changes. The tank also helps to separate the air from liquids.

Results and discussion:-

When studying the model that build on the well and running it notes that the power is transferred from the electric motor to the pump through the return of management, which runs through the water withdrawal tube and this column is an additional load on the engine. As this column is based inside the drag tube with bearings and rotates within these bearings, which generates friction between the shaft and bearings, which causes loss of power as well as losses resulting from the column weight. The presence of the running shaft inside the towing tube reduces the area of the internal drag tube and thus impedes the movement of the water. Therefore, the transfer of power from the engine to the turbo pump via the oil through the hydraulic conveyor pipes eliminates the shaft and thus eliminates the resulting power losses.

The bearings reduce the area of the suction pipe and impede the passage of water inside it. The area through which the water passes through the bearings crosses is approximately 65% of the area of the downflow tube in the well, thus reducing the discharge leading to increased load on the engine.

Since the proposed theoretical model does not require the use of bearings, this increases the area of the suction tube and thus increases the discharge.

The power used by the current theoretical model was calculated by using equation (2) to calculate the power required to operate the water pump at the discharge point after finding the total height of the pump using Equation 3. On the assumption that the pump efficiency is constant and that the pump is directly connected with the hydraulic motor, the actual engine capacity should be increased by 20% on the capacity needed by the pump [5] to avoid loading the engine.

After calculation of the actual capacity consumed by the hydraulic motor in the current theoretical model at the same well specification to give the same discharge and compare it with the calculated capacity of the model that was studied in practice using Equation (1). It was found that the capacity consumed in the theoretical model required to operate the hydraulic motor, and the same discharge to the pump 47% less than the power consumed to operate the electric motor in the model that has been studied in practice, indicating the impact of the runningshaft and bearings and the amount of losses resulting from them.

In addition, the removal of the running shaft and bearings means reducing the cost of manufacturing the pumping system and facilitate the installation of the system on the well artesian. because running shaft consists of several pieces, which requires linking during the installation of the pumping system one after the other and drop it into the well vertically in a straight line Heavy weight is difficult to control, especially in deep wells when the length of the column is too large.

As for the maintenance process in the event of a malfunction in the system studied, the extraction of the water pump requires the extraction and separation of all the supports and running shaft and this process is very expensive, while the maintenance of the system in the new model is very easy and can pull the water pump and the hydraulic engine By a pull wire that is attached to them when they are lowered.

On the other hand, it is necessary to use grease to lubricate the contact areas of the shaft with the plants in the model that has been studied in practice to reduce the friction, which leads to contamination of the water out of the wells with these greases. In the new model, due to the removal of the bearings and the running shaft.

Conclusions and recommendations:-

The use of the running shaft to transfer the power from the engine to the pump causes loss of power due to the weight of the shaft and the friction with the bearing that are based on it inside the water suction tube.

The presence of bearing inside the water suction tube reduces the internal area of the tube and thus impedes water flow and reduces drainage.

Manufacturing a practical model for hydraulic pump for use in artesian wells

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