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Fabrication of Dual Side Water Pump System by Using Scotch Yoke Mechanism

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***Abstract*- This paper gives information about a working model of dual side water pumping system by using scotch yoke mechanism. The scotch yoke mechanism is used to increase the maximum discharge is to needed and is used to another application to converts the rotary motion into linear reciprocating motion. The aim of the project to increase the discharge of the pump**

***Index terms*- Scotch yoke mechanism, Dual water pumping system, reciprocating pump, Electric power.**

I.INTRODUCTION

All of as we need of some kind of water source for irrigation, washing clothes, preparing food, drinking bathing. We may get the water from different source like open well, ponds, river, lake, bore well and the water use from various purposes. Pump work on different mechanism (like reciprocating and rotary), and consume the energy to perform mechanical work by moving the water, fluid etc. Pump operate various source, including electricity, engine, wind power and manual operation it is also used in many sizes that vary from microscopic for use in large industrial pump and medical applications. The scotch yoke mechanism is also used for convert the rotational motion into liner reciprocating motion. Linear motion can takes place in different forms depending on the shape and size of slot, but mostly the basic scotch yoke with a constant rotation speed develop in a linear motion that is a simple harmonic in nature.

II. LITERATURE REVIEW

C. Gopal et al.7 have reviewed the research developments with Renewable Energy Source Water Pumping System (RESWPSs).

R. Praveen Kumar.3 In this paper we have get the knowledge about how to fabricate the working model of the Dual side water pumping system using scotch yoke mechanism. (This method of pumping water is very efficient compared to other pumping system. The implementation of the design will definitely give excellent performance to the society.)

III. WORKING PRINCIPLE

It work on the principle of scotch yoke mechanism. The scotch yoke mechanism is also known as slotted link mechanism is a reciprocating mechanism, converts the linear motion of a slider into rotational motion, or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engage a pin on the rotating parts. The location of the piston versus time is a sine wave constant amplitude, and constant frequency given a constant rotational speed.

IV. EXPERIMENTAL WORK

A. Experimental setup

The work on scotch yoke mechanism the main function of scotch yoke is converts the rotary motion into reciprocating motion. The main function of this pump depends on the reciprocating motion of the piston. The store water enters from the inlet with pipes. The water is enters the cylinder, here the piston is compresses and deliver the water with a very high pressure. The piston are reciprocated by a cam plate.

The cam plate supported by ball bearing on the both side to rest on the cam plate with a motor shaft. When the cam plate is made to rotate the piston is moves to the bottom dead center (BDC). When this

happens the suction of water is an action. This is carried out by the piston.
The water is sucked from the storage tank to the piston cylinder through pipes and ports. When cam plate rotates or the piston is also reciprocating motion. The piston force towards the top dead center (TDC). Due to this force the delivered from the water from the cylinder carried out. The water is delivered one way valve. The delivery action takes place on the piston alternatively.
If the flow of water will be constant. The water deliver will be very high pressure. The high pressure water is taken through pipes and utilizes for various purposes in small industry like servicing station, car washing center, agriculture purpose etc.

Actual working model

C. Specifications:
1. Motor
Maximum Power : 0.5HP
Maximum Voltage: 220 V AC
Maximum Speed : 1440 RPM
Current: 3.5 amps

2. Scotch Yoke
Stroke length of the pump = 140 mm
Diameter of cam plate = 140 mm
Cam plate Thickness = 2.5 mm
Inner daimeter of roller = 5 mm
Outer diameter of roller = 8 mm
Inside yoke length = 8 mm
Outside yoke length = 140 mm
Inside yoke width = 28 mm
Outside yoke width = 36 mm
Bearing diameter = 26 mm
Connecting rod length = 140 mm
Diameter of the pulley = 270 mm
Width of belt = 12 mm
Thickness of belt = 8 mm
Suction and Delivery pipe diameter
Outer diameter of the pipe = 40 mm
Inner diameter of the pipe = 32 mm

Cost Estimation
Motor = 1650/-
Pipes and Tubes =500/-
Pumping elements =2100/-
Scotch Yoke Mechanism = 1700/-
Machining Cost =850/-
Supporting elements =800/-
Other expenses =1200/-
Overall Cost =8800/-

Important Equations and Calculations
Velocity of Water flow in pipe
V= Q/A A=$\frac{\pi}{4} * D^2$
Where,
Q = Discharge of the water in the pipe in (LPH)
A = Area of the pipe in (m2)
D = Diameter of the pipe in (m)
Diameter of suction and delivery pipe will be 34 mm.
Area of the pipe= $\frac{\pi}{4} * (32)^2$
A = 0.804 m^2
From the standard data
The capacity of the flow = 720–3150 LPH
We are taking 3000 LPH (1000 lit = 1m^3) Capacity of flow = $\frac{3000}{1000}$ = 3 m^3/hour.
V= $\frac{3}{0.907}$
V = 3.73 m/sec
So the power requirement for motor will calculated by the following calculation,
Output power = $\frac{\rho \times g \times H \times Q}{1000}$
$= \frac{100 \times 9.81 \times 31 \times \frac{3}{3600}}{1000}$
= 0.253 KW.
Pump Efficiency= $\frac{Output\ power}{Input\ power} \times 100$
$=. \frac{0.253}{0.350} \times 100$
= 72.28 %
Power Motor (P) = $\frac{Q \times H \times g \times p}{pump\ efficiency}$
Where,
Q = Discharge of the water

H = Head (m)
g = specific gravity of the water (9.81)
r = Density of the water (1000 kg/m^3)

Power (P_{Motor}) = $\frac{\frac{3}{3600}\times 31\times 9.81\times 1000}{0.722}$

= 350.61 KW.

P_{Motor} = 0.350 KW.

We know that the power of the motor, now we have to find the torque of the motor by using the power torque relation,

$P = \frac{2\times\pi\times N\times T}{60}$

$T = \frac{P\times 60}{2\times\pi\times N}$

Where,
P = Power of the motor (watts)
T = Torque of the motor (Nm)
N = Speed of rotation of motor (rpm)

$T = \frac{350.61\times 60}{2\times\pi\times 1440}$

T= 2.325 Nm

Finally, we are getting the following results

Discharge of the water (Q) = 3.000 $\frac{m^3}{hour}$

Speed of the motor (N) = 1440 rpm
Power (P) = 0.350 KW
Torque (T) = 2.325 Nm

V.CONCLUSION

We have successfully fabricated the dual side water pump system as per the design specification. The practical performance of this device provides to be successful, with case of operation and safety, hence the results have given a clear indication of its commercial viability. After the practical we have concluded that dual side pump system works better than the single pump system. By using of this method, we have achieved the double output using single input power.

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