DESIGN AND FABRICATION OF DUAL PUMP SYSTEM BY USING SCOTCH YOKE MECHANISM

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ABSTRACT

The aim of the project Is to design and develop a dual side water pumping system using scotch yoke mechanism. The reciprocating motion of the plunger is utilized for the pumping action. The plunger is reciprocated with the help of a cam plate. By this action the water is pumped with very high pressure and to various heads. This can be utilized for various applications like lubrication in machines and water pumping in agriculture field. The cam plate gets the drive from the motor for its rotation and converts that rotary motion to useful dual side reciprocating motion. The motor is powered with the aid of electric power. Thus the water is pumped from source to various head

Increasing the productivity is one of the main requirements of production engineering in any kind of manufacturing industry. Either by reducing the operation time or by improving the capability of the machine to produce the components in an increased number at the same time is very essential for an industry to achieve the same. This project employs the Scotch yoke mechanism in water pumping machine which enables it to pumping water from two pumps at a time there by improving the productivity. In today's world time a machine should be less time consuming. Pump fill one piece at one time so there was a loss in production rate. Double acting water pumping overcomes this time consuming problem. Double acting water pumping system fills two material simultaneously by its scotch yoke mechanism, so the production rate increase twice then that of pump. Double acting water pumping works under by the scotch yoke mechanism. The scotch yoke of mechanism convert the rotary motion into the reciprocating motion.

Keyword: - *Dual water pumping system, Scotch yoke mechanism, Non-return valve, and reciprocating pump.*

1. INTRODUCTION

Every one of us will need of some kind of water source for drinking, bathing, washing clothes, preparing food and for irrigation. We may get the water from various sources like, lake, river, ponds, open well, bore well. So we have to pump the water from the source and use the water for the various purposes. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power which usually come in many sizes that vary from microscopic for use in medical applications to large industrial pumps. Generally these mechanical pumps have numerous applications such as pumping water from wells, filtering of dust in the aquarium, filtering the ponds and aeration, also used in car industry for water-cooling and fuel injection, and finally in the energy industry for pumping oil and natural gas or for operating cooling towers. This Scotch yoke mechanism could be used for conversion between rotational motion and linear reciprocating motion. In general this linear motion can take place in various forms depending on the shape of the slot, but mostly the basic yoke with a constant rotation speed produces a linear motion that is simple harmonic in nature.

1.1 Dual side water pumping system

To design and develop dual side water pumping system using scotch yoke mechanism. The reciprocating motion of the plunger is utilized for the pumping action. The plunger is reciprocated with the help of a cam plate. By this action the water is pumped with very high pressure and to various heads. This can be utilized for various applications like lubrication in machines and water pumping in agriculture field. The cam plate gets the drive from the motor for its rotation and converts that rotary motion to useful dual side reciprocating motion. The motor is powered with the aid of electric power. Thus the water is pumped from source to various heads.

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2. WORKING PRINCIPLE

It works on the principle of Scotch yoke mechanism. The Scotch yoke also known as slotted link mechanism is a reciprocating motion mechanism, converting 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 engages a pin on the rotating part. The location of the piston versus time is a sine wave of constant amplitude, and constant frequency given a constant rotational speed.

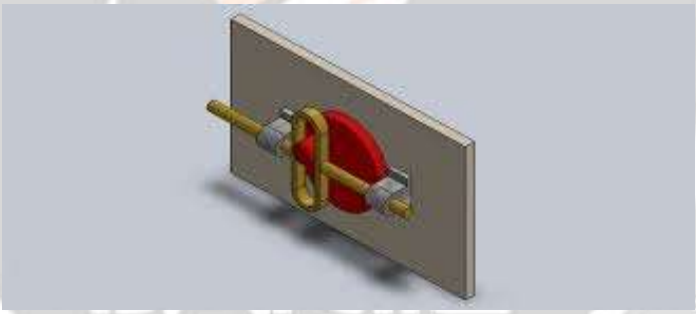

Figure -1: Scotch yoke mechanism

3. DESIGN CALCULATIONS

Velocity of water in flow pipe:

$V = \frac{Q}{A}$

Where,

Q = Discharge of the water in the pipe in (LPH)

A = Area of the pipe in (m)

D = Diameter of the pipe in (m)

Diameter of suction and delivery pipe will be 34mm.

Area of the pipe $=(\pi/4)*(34)^2$

From the standard data

The capacity of flow= 720-3150 LPH

We are taking 3000 LPH (1000Lit=1m3)

Capacity of flow =(3000/1000) =3m3/hour
V = 3/0.907 m/sec

V = 3.30m/sec
So the power requirements for motor will calculated by the following calculation,
Output power = (ρ*g*Q*H)/1000
Where,
Q= Discharge of the water
H= head (m)
G= specific of gravity of the water (9.81)

ρ = Density of the water (1000kg/m^3)
ρ =0.245KW

Pump Efficiency = (Out put power/Input power)*100
Pump Efficiency = 70.8%

Power (P_{motor}) = Out put power/ Pump eficiency
P_{motor} = 0.346kw

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

P = (2*π*N*T)/60

Where,

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

T = 2.297Nm

4. METHODOLOGY

The methodology involves steps involved in fabrication and working of model. Here power is supplied to the AC motor and the output speed of the motor is manipulated by using Gear box as required. Then that transferred to the mechanism. Bellow fig 2. Illustrate the overall working concept.

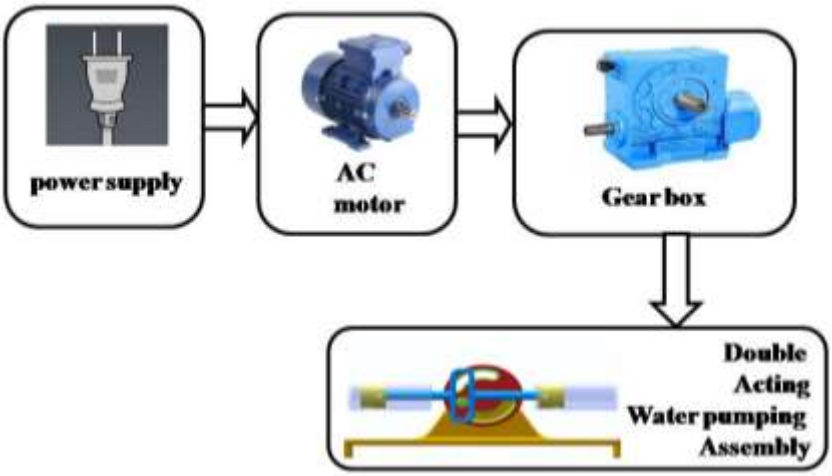

Figure: 2. flow chart

When the power is supplied to the 12v Dc motor, shaft and crank attached to the shaft start rotating. As the crank rotates the pin slides inside the yoke and also moves the yoke forward. When the crank rotates through in clockwise direction the yoke will get a displacement in the forward direction. The maximum displacement will be equal to the length of the crank. When the crank completes the next of rotation the yoke comes back to its initial position. For the next of rotation, yoke moves in the backward direction. When the crank completes a full rotation the yoke moves back to the initial position. For a complete rotation of crank the yoke moves through a length equal to double the length of the crank. The displacement of the yoke can be controlled by varying the length of the crank.

Figure 3:Model of dual pump system.

4.1 Cylinder and check valve

A Hydraulic cylinder (also called a linear hydraulic motor) is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. A double-acting cylinder is a cylinder in which the working fluid acts alternately on both sides of the piston. In order to connect the piston in a double-acting cylinder to an external mechanism, such as scotch yoke mechanism, a hole is provided in one end of the cylinder for the piston rod and this is fitted with a gland or 'stuffing box' to prevent escape of the working fluid.

Non-return valve or check valve is a valve that normally allows fluid (liquid or gas) to flow through it in only one direction. Check valves are two-port valves, meaning they have two openings in the body, one for fluid to enter and the other for fluid to leave. There are various types of check valves used in a wide variety of applications. Check valves are often part of common household items. Although they are available in a wide range of sizes and costs, check valves generally are very small, simple, or inexpensive. Check valves work automatically and most are not controlled by a person or any external control; accordingly, most do not have any valve handle or stem. The bodies (external shells) of most check valves are made of plastic or metal.

5. CONCLUSIONS

We have designed and fabricated dual pump system. After practical demonstration it is conclude that dual pump system works better than single pump system. By using this we can achieve double output using single input power.

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