Elevator Water Pump

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Abstract: In recent years there are more difficulties in supplying of water which impose the necessity of finding new technical solutions that will provide reliable and efficient work for lifting of sump fluid to the surface. In future, there is more civilization will take place in metro cities. Population will be more. To fulfill the basic needs of mankind like food, cloths and house, Man is going to innovate modern systems. So, there will be more requirements of electricity but in worldwide, there is an important issue of consideration. So there is need for other innovative technologies. Electricity saving is more essential. Our project is little helpful for Electricity Saving in modern housing societies. We have such concept that will help to reduce power consumption Housing complexes, Business parks, Malls etc. In our project we are using the force exerted by Elevator, while coming downward, to lift the water from the sump without using conventional pumping system which includes less electricity consumption. We hope this concept can help in modern infrastructure to save Electricity as well as Cost. The new prototype has been tested and the results are presented in this paper.

Index Terms– *Elevator, Pump, Lift, Fluid Dynamics, Water Pump.*

I. INTRODUCTION

In future, there is more civilization will take place in metro cities Population will be more. To fulfill the basic needs of mankind like food, cloths and house, Man is going to innovate modern systems. So, there will be more requirements of electricity but in worldwide, there is an important issue of consideration. So there is need for other innovative technologies. Electricity saving is more essential. Our project is little help for Electricity Saving in modern housing societies. We have such concept that will help to reduce power consumption Housing complexes, Business parks, Malls etc. We hope this concept can help in modern infrastructure to save Electricity as well as Cost. It is very useful to find out new ideas about machines modification in engineering equipments or many other items. It will give well engineering knowledge about this purpose we discuss in our group with our guide teacher because of advance of engineering science and invention coming in market for improving productivity as far as possible. Before starting any project its planning is to be done it is very important because whole project depends on it each and every items details and assembly should be as per the planning so the great care can be taken. An elevator is a device used for lifting or lowering a load by means of lift-wheel around which rope or chain wraps. It is operated manually, electrically or pneumatically driven and may use chain, fiber or wire rope as its lifting medium. A lifting hook is used to lift the load. The elevators can be applied across all industry sectors; from healthcare to construction, most industries and commercial will use some kind of lifting equipment. Innovative, complex and powerful lifting equipment is now available for use. The principal of load-lifting mechanism are the frame, the lifting mechanism, and the carrying system. Self-propelled machines are equipped with a mechanism for movement and rotating types are equipped with a rotating mechanism. The load-grasping mechanism, like the design of the machine itself, depends on the size, weight, and nature of the load to be moved, as well as on the technical aspects of manufacturing process involved. For lifting and lowering people the machine is equipped with cabins for moving piece goods it has hooks and various special grips; and for bulk materials, it has buckets, dippers, or graders. The selection of lift pumps for water supply systems is a frequent exercise in building services and design in developing environments. This is due to the erratic nature of the pressure of the city mains supply. Private borehole water supplies also require lifting to high elevations from which distribution is effected by virtue of gravity. A common lifting arrangement is shown in Fig 1. Water flows from the city mains into a low level tank. A pump then raises the water into a high level tank. The procedure for selecting the lift pump utilizes two important parameters: the discharge rate and the total pressure head. The discharge rate is determined by the desired rate of filling the high level tank, while the total head is determined by the total pressure loss of the system which the pump should overcome in duty. The total system head is an addition of the height of the high level storage above the pump, the frictional head loss, the head loss due to pipe fittings and valves, and height of the pump above the low level storage. The pump selection procedure involves calculating total heads for varying discharge rates. A graph of system head against flow rate is thereby generated and superimposed onto the characteristic head versus flow rate curves of a particular set of pumps. A pump having a characteristic curve which cuts the system head near the point of peak efficiency of the set of pumps is then selected for the duty.

II. LITERATURE REVIEW

An elevator is a type of vertical transport equipment that efficiently moves people or goods between floors (levels, decks) of a building, vessel or other structure. Elevators are generally powered by electric motors that either drive traction cables or counterweight systems like a hoist, or pump hydraulic fluid to raise a cylindrical piston like a jack. Because of wheelchair access laws, elevators are often a legal requirement in new multistory buildings, especially where wheelchair ramps would be impractical. Some people argue that lifts began as simple rope or chain hoists (see Traction elevators below). A lift is essentially a platform that is either pulled or pushed up by a mechanical means. A modern day lift consists of a cage mounted on a platform within an enclosed space called a shaft or sometimes a "hoistway". In the past, lift drive mechanisms were powered by steam and water hydraulic pistons or by hand. In a "traction" lift, cars are pulled up by means of rolling steel ropes over a deeply grooved pulley, commonly called a sheave in the industry. The friction between the ropes and the pulley furnishes the traction which gives this type of lift its name.elevator debuted mid-19th century in the US as a simple freight hoist operating between just two floors in a New York City building. In 1853, Elisha Graves Otis was at the New York Crystal Palace exposition, demonstrating an elevator with a “safety” to break the cab’s fall in case of rope failure, a defining moment in elevator development. By 1857, the country’s first Otis passenger elevator was in operation at a New York City department store, and, ten years later, Elisha’s sons went on to found Otis Brothers and Company in Yonkers, NY, eventually to achieve mass production of elevators in the thousands. Today, Otis is the world’s largest elevator manufacturer. In 1889 came the direct-connected geared electric elevator, allowing for the building of significantly taller structures. By 1903, this design had evolved into the gearless traction electric elevator, allowing hundred-plus story buildings to become possible and forever changing the urban landscape. Multi-speed motors replaced the original single-speed models to help with landing-leveling and smoother overall operation. Electromagnet technology replaced manual rope-driven switching and braking. Push-button controls and various complex signal systems modernized the elevator even further and safety became an integral part of the design. The year 1926 saw the birth of the modern elevator in the Woolworth building, then the tallest building in the world. The progress in this field has been astonishing ever since, and today we have intelligent elevator systems that can be remotely tracked for maintenance and rework.

III. METHODOLOGY AND EXPERIMENTATION

In our project we are using the force exerted by Elevator, while coming downward, to lift the water from the sump without using conventional pumping system which includes electricity consumption.

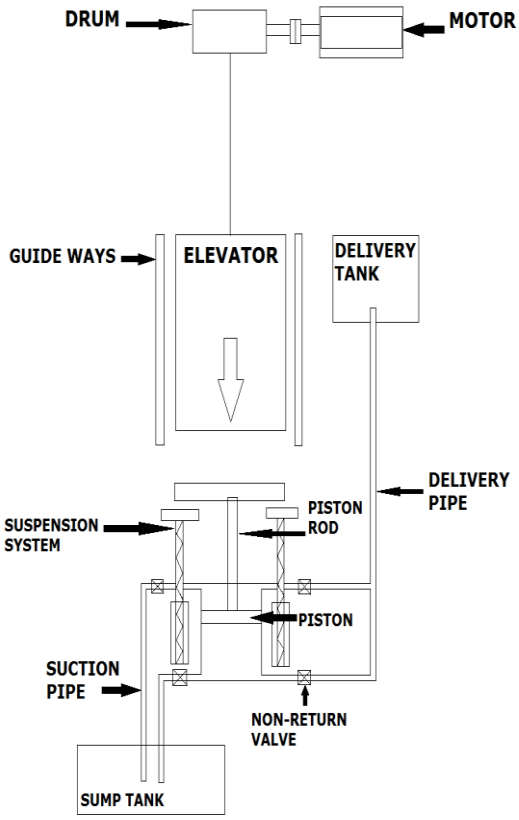

Fig.1 Block Diagram

3.1 CONSTRUCTION

- Our project design consist of cylindrical tank, double headed piston, non return valves, suction pipe, delivery pipe and compression spring.
- The cylindrical tank is provided at the basement of the elevator passage.
- The bottom head of the piston is inserted in tank. The other head is kept outside the tank.
- Compression springs are situated at the four orientations outside the tank.
- The suction pipe is connected to the tank from the water storage which is at ground level.
- The delivery pipe is connected to water storage which is at the top of the building from water tank.
- The non-return valves are provided one at suction pipe and one at delivery pipe.

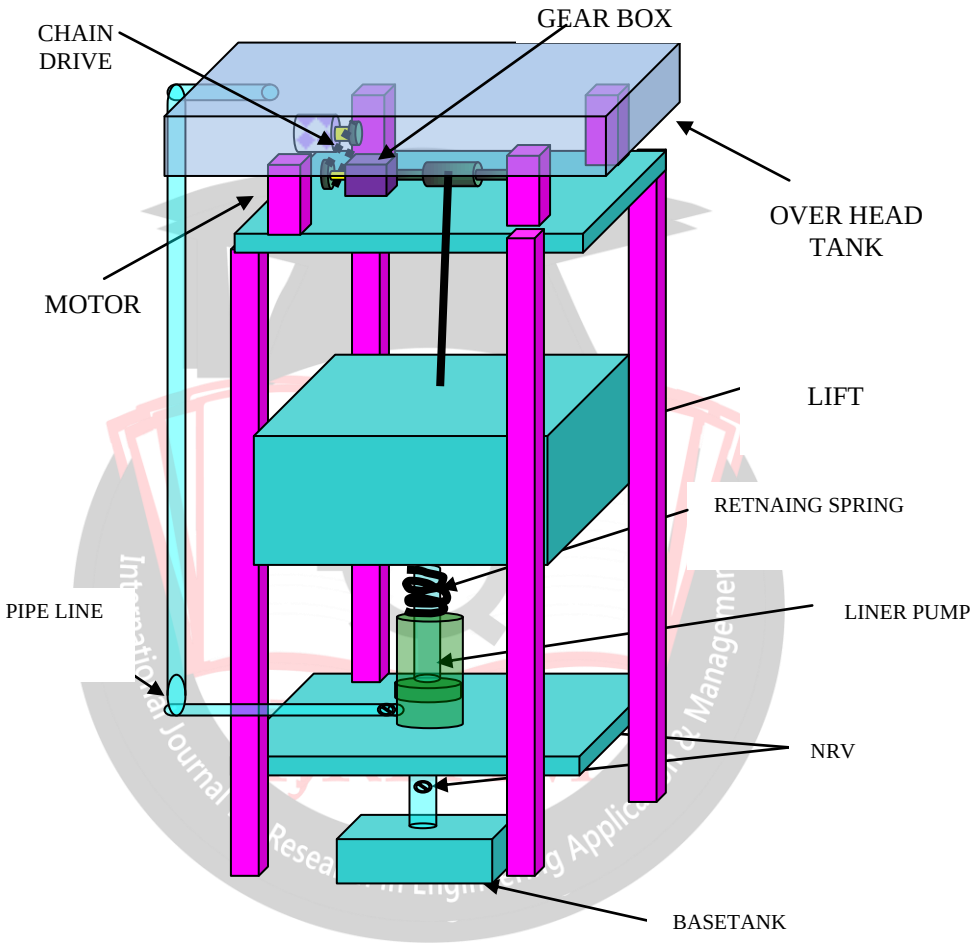

Fig.2 3-D MODEL OF 'LIFT PUMP'

3.2 WORKING

The water will be supplied into the tank from the water storage automatically because of pressure level difference.

- When lift will come at the ground floor, it will press the piston in the tank. And it will also press the compression springs.
- The double headed piston will act as a piston in the reciprocating pump. It will push the water to the delivery pipe.
- The non-return valve will opened and the water will be supplied to the storage which is located at the top of the building through the delivery pipe.
- When the elevator moves upwards there will be no load on the piston. The energy stored in compression springs is released and it will push piston upwards to its initial position.
- Whenever elevator comes at ground, this cycle will be repeated.

IV. COMPONENTS AND DESIGN CALCULATION

This chapter describes some of the mathematical technique used by designers of complex structures. Mathematical models and analysis are briefly describe and detail description is given of the finite – element method of structural analysis. Solution techniques are presented for static, dynamic & model analysis problems. As part of the design procedure the designer must be analyses the entire structure and some of its components. To perform this analysis the designer will develop mathematical models of structure that are approximation of the real structure, these models are used to determine the important parameters in the design .The type of structural model the designer uses depends on the information that is needed and the type of analysis the designer can perform.
Three types of structural models are

4.1 Rigid Members: The entire structure parts of the structure are considered to be rigid, hence no deformation can occur in these members.

4.2 Flexible members : The entire structure parts of the structure are modeled by members that can deform, but in limited ways. Examples of this members trusses, beams and plates.

4.3 Continuum : A continuum model of structure is the most general, since few if any mathematical assumptions about the behaviour of the structure need to be made prior to making a continuum model. A continuum member is based on the full three – dimensional equations of continuum models.

In selecting a model of the structure, the designer also must consider type of analysis to be performed. Four typical analysis that designers perform are:

4.4 Static equilibrium : In this analysis the designer is trying to the determine the overall forces and moments that the design will undergo. The analysis is usually done with a rigid members of model of structure and is the simplest analysis to perform.

4.5 Deformation : This analysis is concerned with how much the structure will move when operating under the design loads. This analysis is usually done with flexible members.

4.6 Stress : In this analysis the designers wants a very detailed picture of where and at what level the stresses are in the design. This analysis usually done with continuum members.

4.7 Frequency : This analysis is concerned with determining the natural frequencies and made shape of a structure. This analysis can be done with either flexible members of a structure. This analysis can be done with either flexible members or continuum members but now the mass of the members is included in the analysis.
The subject of MACHINE DESIGN deals with the art of designing machine of structure. It is a combination of resistance parts with successfully constrained relative motions which is used for transferring different forms of energy into mechanical energy or modifying available design is to create new and better. It is the practical application of machinery to the design and construction of machine and structure. In order to design simple component satisfactorily, a sound knowledge of applied science is essential. In addition, strength and properties of materials including some metrological are of prime importance. Knowledge of theory of machine and other branch of applied mechanics is also required in order to know the velocity. Acceleration and inertia force of the various links in motion, mechanics of machinery involve the design.

4.8 Concept in Machine Design Process.

4.8.1 Consideration in Machine Design

When a machine is to be designed the following points to be considered: -

- Types of load and stresses caused by the load.
- Motion of the parts and kinematics of machine. This deals with the type of motion i.e. reciprocating. Rotary and oscillatory.
- Selection of material & factors like strength, durability, weight, corrosion resistant, weld ability, machine ability are considered.
- Form and size of the components.
- Frictional resistances and ease of lubrication.
- Convince and economical in operation.
- Use of standard parts.
- Facilities available for manufacturing.

- Cost of making the machine.
- Number of machine or product are manufactured.

V. SELECTION OF MATERIAL

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the effect, which the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

- Availability of the materials.
- Suitability of materials for the working condition in service.
- The cost of materials.
- Physical and chemical properties of material.
- Mechanical properties of material.

The mechanical properties of the metals are those, which are associated with the ability of the material to resist mechanical forces and load. We shall now discuss these properties as follows:

- Strength
- Stress
- Stiffness
- Elasticity
- Plasticity
- Ductility
- Brittleness
- Malleability
- Toughness
- Resilience
- Creep
- Hardness

In engineering practice, the machine parts are subjected to various forces, which may be due to either one or more of the following.

- Energy transmitted
- Weight of machine
- Frictional resistance
- Inertia of reciprocating parts
- Change of temperature
- Lack of balance of moving parts

The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should with stand it. Another criteria for selection of metal depend upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load.

Selection of the material depends upon factor of safety, which in turn depends upon the following factors.

- Reliabilities of properties
- Reliability of applied load
- The certainty as to exact mode of failure
- The extent of simplifying assumptions
- The extent of localized
- The extent of initial stresses set up during manufacturing
- The extent loss of life if failure occurs
- The extent of loss of property if failure occurs

Base plate, motor support, sleeve and shaft

Materials selected in m/c

Material used:

Mild steel

Reasons:

- Mild steel is readily available in market
- It is economical to use
- It is available in standard sizes
- It has good mechanical properties i.e. it is easily machinable
- It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure
- It has high tensile strength
- Low co-efficient of thermal expansion

Properties of mild steel:
M.S. has carbon content from 0.15% to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both the ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases.
Mild steel serve the purpose and was hence was selected because of the above purpose.
BRIGHT MATERIAL:

It is a machine drawn. The main basic difference between mild steel and bright metal is that mild steel plates and bars are forged in the forging machine by means is not forged. But the materials are drawn from the dies in the plastic state. Therefore the material has good surface finish than mild steel and has no carbon deposits on its surface for extrusion and formation of engineering materials thus giving them a good surface finish and though retaining their metallic properties.

Materials used,

- Mild steel is an alloy of iron and carbon, with carbon content up to a maximum of 1.5%. The carbon occurs in the form of iron carbide, because of its ability to increase the hardness and strength of steel. Other elements are silicon, phosphorous, mg etc, are certain in greater or lesser amount to impact certain desired properties to it, Most of the steel are produced nowadays I plain carbon or popularly called mild steel of simply carbon steel.
- Dead mild steel ; upto 0.15 % Carbon
- Low carbon steel : upto 0.15 % to 0.45
- Medium carbon steel : upto 0.45% to 0.8 %
- High carbon steel : 0.8 % to 1.5 % Carbon

Properties of mild steel

- Mild steel is easily available in the market.
- It is economical to use.
- It is available in the standard size.
- It has good mechanical properties. i.e. easily machinable.
- It has high tensile strength.
- It has low co efficient of thermal expansion.

VI. Future Scope And Its Application
In modern age, when we are facing problems like load shading, electricity consumption then the “Elevator Water Pump” is very useful. It can be used anywhere, when there is frequent use of elevator occurs. The main aim of this project is to utilize the downward force of elevator, which is going to waste. And by doing this, electricity consumption will be less than conventional water pumping system which is done by electrical centrifuging pump. Our system will work as a supplementary system to this conventional system. The elevator water pump can no give the continuous discharge. This system can be applicable and beneficial in the following sectors.

- Housing complexes.
- Business parks
- IT parks
- Shopping complexes
- Multiplexes
- Hotels

CONCLUSION

After doing this project we conclude that if we use lift pump instead of motor to transfer the fluid at 1.82m height or head we will save power of 1 bhp for 6 feet height.
Diameter of cylinder: $0.15m^2$
Length of stroke: $0.3m^23$
Average working hours for lift: 18 hours
Average upward and downward travel of lift in 1 hour: 50
Total upward and downward motion in a day= 25*18=450
Required downward motion= 450/2=225

Total volume of water lifted = $0.785*D^2*L$
$=0.785*0.15^2*0.3$
$=5.28*10^{-3}m^3$

Discharge= No. of stroke * volume
$=225 * 5.28*10^{-3}$-3
$=1.188\ m^3$/18 hours
=0.183 LPS

For this particular discharge the requirement would be 750 watts i.e 1 hp (approx)

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