



Research Paper

DESIGN AND FABRICATION OF DOUBLE ACTING WINCH TYPE ELEVATOR

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The growth of technologies requested higher performance machine in order to fulfill human needs and market. This machine is implement to make human work easier besides can reduce the uses of human work easier and can reduce the use of human power because of its potential application. The machine double acting winch type elevator can lift the two load or bucket using one motor at the same time. Earlier, winch type elevator can lift one bucket at a time and while returning it does not give any useful work. So we this disadvantage by attaching two bucket on the two winch operated by same motor. The machine is based on the principle of lifting machine. But in this case when one bucket moves up the other bucket goes down due to the arrangement of its rope and cylinder and this will utilize the power of the returning stroke.

Keywords: Bucket elevator, Material handling equipment

INTRODUCTION

An elevator is a device used for lifting or lowering a load by means of a drum or lift-wheel around which rope or chain wraps. It may be manually operated, electrically or pneumatically driven and may use chain, fiber or wire rope as its lifting medium. The load is attached to the hoist by means of a lifting hook. The range of lifting machines can be applied across all industry sectors; from healthcare to construction, most industries and commercial activity will use some kind of lifting equipment. Technological progress has meant that innovative, often complex and powerful lifting equipment is now available for use.

The principal parts of load-lifting machines are the frame, the lifting mechanism, and the carrying (grasping) system. Self-propelled machines are equipped with a mechanism for movement; rotating types are equipped with a rotation 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 and cages; for moving piece goods it has hooks and various special grips; and for bulk materials, it has buckets, dippers, or graders.

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In double acting winch type elevator there are two bucket attached with a lever pulley and it connected with a long rope through electric motor that's why it is known as Double acting winch type elevator. The bucket elevator is probably the oldest known form of conveyor, Its history can be traced back to the days of Babylon where wicker baskets lined with a natural pitch and fastened to ropes operating over wooden sheaves turned by slaves, were used for the elevating of water into irrigation ditches.

It consists of:

- Buckets to contain the material;
- A belt to carry the buckets and transmit the pull;
- Means to drive the belt.
- Accessories for loading the buckets or picking up the material, for receiving the discharged material, for maintaining the belt tension and for enclosing and protecting the elevator.

A bucket elevator can elevate a variety of bulk materials from light to heavy and from fine to large lumps. A centrifugal discharge elevator may be vertical or inclined. Vertical elevators depend entirely on the action of centrifugal force to get the material into the discharge chute and must be run at speeds relatively high.

LITERATURE REVIEW

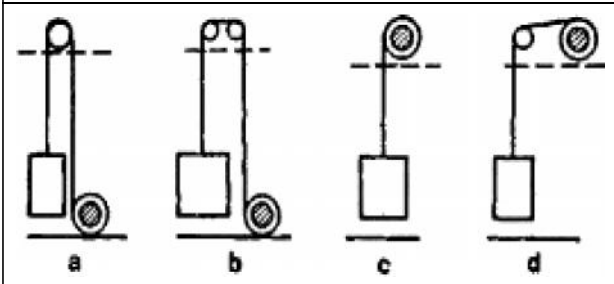
Rudimentary elevators, or hoists, were in use during the middle ages and can be traced back to the third century BC. They were operated by animal and human power or by water-driven mechanisms. The power elevator debuted mid-19th century in the US as a simple

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.

Review of Existing Winch Type Elevator

Existing winch type elevator consists of one pulley, one motor and one bucket. It provides

Figure 1: Shown Single Acting Winch Type Elevators



the useful work while moving up when it elevated the load. While returning it provide no useful work as during returning stroke it just carry the empty bucket to the ground.

Lifting Machine

Lifting Machine is a machine used for lifting and lowering loads, and includes any accessories used in doing so (such as attachments to support, fix or anchor the equipment).

Examples of lifting equipment include:

- Overhead cranes and their supporting runways
- Patient hoists
- Motor vehicle lifts
- Vehicle tail lifts and cranes fitted to vehicles
- A building cleaning cradle and its suspension equipment
- Goods and passenger lifts
- Telehandlers and fork lifts
- Lifting accessories.

Lifting Accessories

Lifting accessories are pieces of equipment that are used to attach the load to lifting equipment, providing a link between the two. Any lifting accessories used between lifting

equipment and the load may need to be taken into account in determining the overall weight of the load.

Examples of lifting accessories include:

- Fiber or rope slings
- Chains (single or multiple leg)
- Hooks
- Eyebolts
- Spreader beams
- Magnetic and vacuum devices.

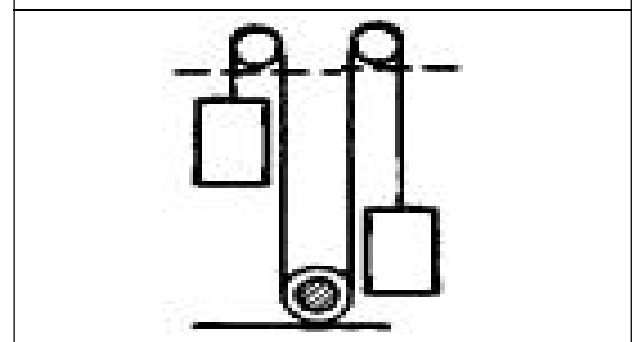
PROBLEM IDENTIFICATION

- In single acting elevator power of motor was wasted during the returning of the bucket as no useful work is done by the elevator.
- It takes more time to lift the same material to higher level. It will be time consuming at the construction site.
- Cost of 3M's (men, machine and material) was more.

SOLUTION OF THE PROBLEM

- Double acting winch type elevator is designed so that it will use the power during the returning stroke by using two bucket with two winches.

Figure 2: Shown Double Acting Winch Type Elevator



- Time of the worker will be utilized as they have to fill and empty the buckets two times in one complete cycle.

METHIDODOLOGY

Specification

RPM of Motor = 1440 rpm

Power of the motor = 1 hp = 0.7457 kw

Diameter of the pulley attached to motor = 0.078 m, $r_1 = 0.039$ m

Diameter of the pulley attached to reduction gear box = 0.15 m, $r_2 = 0.075$ m

Length of the wire = 20 ft = 6.1 m

Diameter of wire (dw) = 8 mm

Type of wire rope = (6 * 7)

Diameter of the cylinder = 8.83 cm = 0.0883 m

Constructional Features of the Machine

- Electric motor
- Reduction gear box
- Rope drum
- Ball bearing
- Plumber block
- Nut and bolt
- Wire rope
- Hook
- Belt and pulley
- Electric switch

Electric Motor

An electric motor is an electromechanical device that converts electrical energy into mechanical energy. Most electric motors

operates through the interaction of magnetic fields and current-carrying conductors to generate force. The reverse process, producing electrical energy from mechanical energy, is done by generators such as an alternator or a dynamo; some electric motors can also be used as generators, for example, a traction motor on a vehicle may perform both tasks. Electric motors and generators are commonly referred to as electric machines. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current, e.g., a battery powered portable device or motor vehicle, or by alternating current from a central electrical distribution grid or inverter. Small motors may be found in electric wristwatches. Medium-size motors of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of ships, pipeline compressors, and water pumps with ratings in the millions of watts.

A 1440 rpm motor is used to provide rotation to the drum. It is held firmly on the base. It requires a power of 1 HP.

Figure 3: Electric Motor



Reduction Gear Box

A machine consists of a power source and a power transmission system, which provides controlled application of the power. Merriam-Webster defines transmission as an assembly of parts including the speed-changing gears and the propeller shaft by which the power is transmitted from an engine to a live axle. Often transmission refers simply to the gearbox that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device.

In British English, the term transmission refers to the whole drive train, including clutch, gearbox, prop shaft (for rear-wheel drive), differential, and final drive shafts. In American English, however, the distinction is made that a gearbox is any device which converts speed and torque, whereas a transmission is a type of gearbox that can be “shifted” to dynamically change the speed-torque ratio such as in a vehicle. A reduction gear box is used to reduce an input speed to a slower output speed and more output torque. It is a wheel work consisting of a connected set of rotating gears by which power is transmitted or motion or torque is changed. We can manufacture and supply single stage, double stage or multistage gear boxes having Single and multiple.

Figure 4: Reduction Gear Box



It provides controlled application of the power. It is an assembly of parts including the speed-changing gears and the propeller shaft by which the power is transmitted. It reduces the rpm of the motor by the ratio 1/40.

Rope Drum

Rope Drums, which are available in different models, shapes and sizes. These Rope Drums are precision engineered and manufactured using optimum grade raw material to ensure toughness, corrosion resistance and high durability. Winch is used to wound rope on it. Winches (drum) are made from high quality of raw material which ensure durability. The diameter of the drum used is 8.83 cm. These Rope Drums are made from high quality of raw material which ensures durability. Avail from us a comprehensive range of precision engineered Rope Drum Hoists. These products are especially designed to meet the challenging operational and safety constraints for industrial crane applications. Our range of Rope Drum Hoists finds its application in typically every type of cranes and suitable for numerous industrial environments as well. We offer our range at the economical prices in different specifications required by the clients Features are:

- Highly efficient
- Premium quality material
- High strength

Figure 5: Rope Drum



Ball Bearing

We used a ball bearing to provide relative motion between the shaft and the second cylinder.

Figure 6: Ball Bearing



Plumber Block

This bearings are used to support the shaft on which cylinder is mounted. The diameter of bearing is 21 mm.

Figure 7: Plumber Block



Nut and Bolt

The nut and bolts are used to connect the two cylinders. They are used to make mechanical linkage between the cylinders.

Figure 8: Nut and Bolt



Wire Rope

Wire rope is a type of rope which consists of several strands of metal wire laid (or 'twisted') into a helix. Initially wrought iron wires were used, but today steel is the main material used for wire ropes. Wire rope is wound on the drum. It is used to lift the load. We used a 20 ft. long wire rope of diameter 8 mm.

Historically wire rope evolved from steel chains which had a record of mechanical failure. While flaws in chain links or solid steel bars can lead to catastrophic failure, flaws in the wires making up a steel cable are less

Figure 9: Wire Rope



critical as the other wires easily take up the load. Friction between the individual wires and strands, as a consequence of their twist, further compensates for any flaws. Steel wires for wire ropes are normally made of non-alloy carbon steel with a carbon content of 0.4 to 0.95%. The tensile forces and to run over sheaves with relatively small diameters.

Hook

Hook is used to lift any object in upward direction. It is used to hold the object to be lifted.

Figure 10: Hook



Belt and Pulley

A pulley is a wheel on an axle that is designed to support movement of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power. A pulley is also called a sheave or drums and may have a groove between two flanges around its circumference. The drive element of a pulley system can be a rope, cable, belt, or chain that runs over the pulley inside the groove. Hero of Alexandria identified the pulley as one of six simple machines used to lift weights. Pulleys are assembled to form a block and tackle in order to provide

Figure 11: Belt and Pulley



mechanical advantage to apply large forces. Pulleys are also assembled as part of belt and chain drives in order to transmit power from one rotating shaft to another.

Electric Switch

Range of Reverse Forward Switches is made of premium quality raw material. Precision engineered, these switches are finished with rational designing that makes the units easy to operate and install. Our range of Reverse Forward Switches undergoes a series of quality tests at every stage to ensure that it conforms to the Industry quality standards. These Reverse Forward Switches are used in many Industrial applications due to their superior quality and features. The Reverse Forward Switches are available in a wide range.

Figure 12: Electric Switch



Specification Range

16 A, 25 A and 32 A

Rated Voltage

415 V AC 50 Hz

Working Procedure

Let initially bucket 1 is at the bottom position and bucket 2 is at the top position. Now bucket 1 loaded. When we start the motor cylinder 1 starts wounding the wire rope this will elevate the 1 cylinder at the same time second cylinder opens the rope this will lead the second bucket to the bottom surface. After some time bucket first reach to maximum position and second bucket to down most position. At this place 1 bucket will be unloaded and 2 bucket will be loaded.

Now we will rotate the motor in reverse direction this will make the 1 cylinder to open and 2 cylinders to wound. This will provide the first empty bucket a downward motion and second bucket an upward motion till first bucket reach the earth and second bucket to top position this process will be continuous as per desired.

Calculation

Let,

N_1 = rpm of the motor

N_2 = rpm of the gear box

D_1 = diameter of the pulley attached to the motor

D_2 = diameter of the pulley attached to the gear box

L = Length of the belt

- Velocity ratio: $N_1/N_2 = D_2/D_1$, using values in formula we get, $N_2 = 748.8$ rpm say 750 rpm.

- Length of the belt: $L = \Pi(r_1 + r_2) + 2\Pi + (r_2 - r_1)^2/x$. Using values in formula we get, $L = 0.718$ m.
- Drum speed = speed ratio of reduction gear * input speed to reduction gear in rpm
 $(1/40) * (750) = 18.75$ rpm.

CONCLUSION

Our project can be used as small scale industries as well as in domestic purpose. This is having a very low initial and maintenance cost. The main important part of our project is there are two buckets which are very helpful to lift the weight in shorter period of time. This project utilizes the power of the return stroke transfers the same material in the same time. It is useful as it reduces human effort. Conventional machine is useful where only some material is to be elevated. But for bulk as in construction site double acting elevator has advantage over conventional one. Thus overall the project is having a great advantage thus can be used in domestic purpose in future.

FUTURE DEVELOPMENT**Portability**

It can be made portable, which makes it lighter thus allows it to be used at any place efficiently.

Variation in RPM

For cutting different materials the RPM of the machine needs to be varied thick can be achieved by using a electric deamer which will regulate the RPM of the motor. 🌀

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