



Development of Stairs with Escalator (Stair lift)

¹Vyankatesh B. Emche, ²Nikhil G Lokhande, ³Amit S.Ghade, ⁴Chetan A Samarth

¹Lecturer, ² Lecturer, ³ Lecturer, ⁴ Lecturer

¹Department of Mechanical Engineering,

¹Shri Datta Meghe Polytechnic, Nagpur, India

Abstract: This Paper deals with fabrication of stairs with escalator (stair lift) which consist of rope and pulley mechanism which lifts up and down the platform to move person. This helps the person to facing difficulties in climbing stairs. We propose equipment which could be handled easily by the person, since it is a mechanical engineering project. Our major requirement was that to make the project at low budget as compared to lift with low maintenance without risk of power cut & human life.

Index Terms - Stair with escalator (stair lift), rope and pulley mechanism.

I. INTRODUCTION

There are many old and physically disable peoples in the world and it is difficult for them to climb stairs as compared to normal persons. So to help them and to help the persons who cannot afford lift as their houses are small, the project is made. The most concern of this project is to fabricate a mechanism which will lift them up and put them down whenever they want and at very low budget.

A stair with escalator is a mechanical device for lifting people up & down. Rail is mounted on the stairs on which a platform is attached. The platform is lifted by a simple mechanism of rope & pulley by it is lifted.

Person gets on the platform is lifted when he/she switch on the plug the motor starts, after that the shaft of motor is connected to gearbox (speed reducer) by the Oldham's coupling. The outlet shaft of gearbox is connected to another Oldham's coupling which transmits the power to the spindle to wind or unwind the rope. Winding the rope will lift the platform up & unwinding will make the platform go down.

II. HISTORY OF INVENTION

Advancements in technology made disabled people to lead an independent life and play a more productive role in society. Stairways into buildings present a significant environmental barrier for those with mobility impairments, including older adults. A number of home access solutions that allow users to safely enter and exit the home exist, however these all have some limitations. The purpose of this work was to develop a novel, an inclusive home access solution that integrates a staircase and a lift into one device [1]. The Excel stairway lift system will be installed in order to give people the independence needed to move around their home. The use of two individual stairway lift systems ensures that she can easily move from level to level. A handle placed in between the two stairway lift systems, which will allow them to move from one chair to the other [2]. A novel remote centre mechanism was proposed where in a wheelchair can glide along the stairs. In this system, the angle of the seat on the attitude of the chair changes along the angle of inclination of the user irrelevant of the angle of the wheelchair. An attitude sensor along with a relatively small actuator used, this minimal degree of active control made possible. Usually we find that people neither can drive wheelchairs properly at cross muddy patches nor uneven terrain. Similar is in the case of stair where one approach is use of legs. Advances in robotics have made it possible to build and control machines in every way possible. It is not difficult to build a wheelchair with legs that can climb slopes, step over obstacles, which run along stairs. In 1987 a four legged chair developed by the University of Illinois at Chicago and the Veterans Administration Hines Rehabilitation Research and Development Centre based on research in quadruped walking was developed. This invention could sustain a weight of around 110 kg. In addition, has a capacity of carrying a payload of 113.6 kg [3].

In October 1998, a prototype incorporating a computer controlled pantographic legs and with a simple linear gait walked in the laboratory. However, it did not carry a passenger, and it was using a stationary controller containing complex design. It is due to the legs that a person had to sit in stable position without any movement, which is not very comfortable in many cases. Even there are safety issues concerned with the system. In wheeled systems, the wheels passively support the chair and do not require any control electronics nor needs any maintenance of system. Because of the complexity of the system, safety is a natural concern lack of which people do not opt for this mechanism [4].

A staircase can make climbing of stairs for aged and physically handicapped a breezy affair. This led to use of smart stair lift in Kerala. This stair lift has a rail of 12 meters attached on one side of stair was and has a battery which gives continuous 24V DC current. This system though being most advanced costs up to 0.3million along with maintenance for period of six months and includes installation costs [5].

Elevators have powered electric motors that can drive either traction cables or counterweight systems. Because of the wheelchair access laws and constraints like power consumption, and limited access, occupying large area [6]. There is a rule made for shopping malls and few multi-storied buildings to have elevator or escalator to aid people with disabilities. Stair lift is a mechanical device for lifting people or wheelchairs up and down stairs accordingly, implemented at both sufficiently wide stairs and narrow staircases. A chair attached to the rail for a person to sit [7]. A person on the chair moves along the rail with the help of motorized rail. Stair lifts also known with various names as stair lifts, stair-lifts, chair lifts, stair gliders. There should not be any confusion between chair lift and the lift used by skiers. Smart staircase is a type of lift mounted on the staircase without any modification in civil structures. This smart staircase off course runs on electric power, which may be AC or DC and consists of a motor two rails a sliding chair. The actual size of the smart staircase acting as a lift will depend on length of staircase and can be assembled, and mounted accordingly as per convenience and disassembled easily with little efforts. Lifts are invented long back, then came escalators both being implemented indoor gave rise to mobility problem for physically handicapped and aged who have a habit of moving outdoor. But, installation of lift involves ample amount of time and cost for rails, motor honk, civil structures [8].

Numerous stair lifts have been devised having special features for accommodating the physical needs of the mobility impaired. However the use of stairs with escalator has served primarily as a lifting mechanism used without any external operator. While use of this mechanism is well known for the lifting of the person up and down. The invention is intended for use by all segments of the population having such a need, especially infirm adults or the elderly.

A. Stair with escalator (stair lift) invention

The first stair lift was invented by king of England Henry VII in 1500s. it consist of a pulley and tackle system with servants pulling the ropes to move the platform upward. The king requires the stair lift as he met with an accident in 1536 this caused the severe injury to kings leg and as the medical facilities were not available the king made the stair lift. Though the world's first commercial stair lift was invented by C.C. Crispin in 1920, he called the invention (The Inclinator). Crispin created this device to help his sick friend to move up & down the stairs. He went on establish the Inclinator company of America in 1930, whose stair lift were mostly by victims of polio. At last Patrick Stannah made the modern stair lift in 1975 which we are used in many of the homes in United States of America

B. Smart Stair Lift for Multipurpose Applications

These days, seniors and disable people which cannot climb the stairs because of their improper physical conditions and age issues. For their better accommodation purpose stair lift should be used as per their requirement for climbing stairs in their 1 or 2 Story Homes, Hospitals, Old Age homes. The purpose of designing smart stair lift is to develop better design and comfort that give the aged and disabled people the mobility to travel up and down through stairs. This stair lift can also be used in industries for lifting the various heavy material and machinery

C. Self-Operated Stair Lift

The self-operated stair lift eliminates the external operator. It eliminates human cost and the person standing on the platform feels safe as all the controls are in his hands and he can start and stop the lift whenever and where ever he likes and once it reaches its destination the next person can again continue this process after completing the previous process and this also reduce the accidents caused when two persons are applied for doing same job.

D. Stannah Stair Lift

Stannah Lifts is the company which make the modern stair lift. There are many types of lifts curves lifts, outdoor lifts, indoor lifts, straight lifts and many others. The simple device for transporting people up and down stairs has become popular.

Straight Lifts: The most common stair lift for most common type of stair case.

Curved Lifts: for the staircase which are round. In this type of staircase the platform is fitted on the railings not on the stairs.

Outdoor Stairs: As some properties have outdoor steps either to get into the building or in the garden. Acorn stair lifts was establishing in 1992 and they develop the most modern stair lift yet, the acorn super glide 120.

Standing lifts: in this type of lift the platform for standing is made instead of a seat so that a wheel chair should also attach to it.

III. DESIGN OF STAIRS WITH ESCALATOR (STAIR LIFT)

There are many different types of stair lifts available, but in general they fall into two main categories: straight and curved. The latter are the more customized products, with the stair lift rail having to fit around the shape of your stairs. Most stair lift controls are easy to use and can be set up on either side of the lift. No worries about having to reach over your body to operate the unit. Some high-end models now provide dual controls on each armrest.

3.1 Structural Design

Standing stair lifts are often chosen for installation when a user has a particularly narrow staircase that won't fit a seated lift. Keep in mind, though, that the headroom of the staircase must be high enough to fit your entire standing body. For those with problems bending at the knees, standing stair lifts are often a more suitable option. Some standing stair lifts even have a small ledge to help you keep your balance. Standing lift designs are not appropriate for everyone, however. If you are prone to dizzy spells, or perhaps don't have enough physical strength to stand for a few minutes, then a standing lift could be dangerous despite many models having attached grab rails. The motor is mounted centrally below the main rest. The speed reduction is obtained through the worm gear drive of which the worm is mounted on the shaft of the motor and the wheel is mounted on a shaft perpendicular to the shaft of the motor. On the shaft of the worm wheel two sprockets are mounted, one of which provides motion to the back rest and the other to the leg rest. Roller chain moves over the sprockets. All the sprockets are of the same size since there is no speed reduction caused by the chain drive. The legs of the chair are kept inclined so as to overcome the toppling effect thus giving the lower end of the chair a trapezoidal shape. Wheels are mounted at the base of the legs which gives it the required mobility..

3.2 Electrical Circuit

Working of Forward – Reverse starter control circuit

Forward direction

Push ON button (Forward). The forward contactor coil gets supply through phase R – OFF push button – R2 – Forward contactor coil – F ON push button – phase Y. The forward contactor coil energized and three phase induction motor runs in the forward direction. As soon as forward contactor energized, its auxiliary contact F1 normally closed and F2 becomes normally open.

Now the forward contactor gets supply through phase R – OFF push button – R2 – Forward contactor coil – F1 – phase Y.

Reverse direction

Push ON button (Reverse). The reverse contactor coil gets supply through phase R – OFF push button – F2 – Reverse contactor coil – R ON push button – phase Y. The reverse contactor coil energized and three phase induction motor runs in the reverse direction. As soon as reverse contactor energized, its auxiliary contact R1 becomes normally closed and R2 becomes normally open

Now the reverse contactor gets supply through phase R – OFF push button – F2 – Reverse contactor coil – R1 – phase Y.

3.3 Working of stairs with escalator (stair lift)

Stairs with escalator is a mechanical device for lifting peoples up and down. The project work on the basic principle of rope and pulley mechanism. When the electric supply is given to the AC single phase induction motor of start rotating at 1400 rotations per minute which is then coupled with the Oldham's coupling the output shaft of coupling is given to the worm speed reducer which decreases the 1400 rpm into 72 rpm which is connected to another Oldham's coupling and then to pedestal bearings and finally to wrench. The wrench winds the rope whose one end connected to it and another end is connected to platform. The winding of rope lifts up the platform and the person goes up. This process reversed by making the motor to rotates in anticlockwise direction and the wrench unwind the rope which makes the platform to go down and return back to its initial position and this is how the mechanism of stairs with escalators (stair lift) works and the person or an object is lifted.

3.4 Fabrication

Manufacturing of stairs:- the MS (mild steel) is used for the manufacturing as it is lighter in weight sustainable and cheaper in course so by using MS remanufactured 10 + 1 stair which are welded by arc welding machine and the base length of stairs is 7 inch and total height of stair is the MS mild steel is used for the manufacturing as it is lighter in weight sustainable and cheaper in course so by using MS remanufactured 10 + 1 stair which are welded by arc welding machine and the base length of stairs is 7" and total height of stair is 7.1". Show the inclination of sphere is 40 degree for the safety precautions the yelling is manufactured show the inclination of sphere is 40 degree for the safety precautions railing is manufactured.

3.5 ASSEMBLY

The Mounting Such As One Platform The Mounting Platform Puli Bridge Rollers Are Mounted On The Stairs To Live Human Things Are Very Heavy Material Platform Is Attached With 4 Roller Which Provide The Sliding Movement In Between Two Metals Strip So That They Can Allow Move In Forward And Reverse Direction There Are Two You Group Police Of 3 Diameter Which Are Attached To That Of Stairs And On The Front Side Of Platform The Rope Is Fixed On Both The Police From Where Its Fix In Bridge Which Winds Or Unwind The Rope The Winding And Unwinding Of Rope Lift The Platform Up And Down.

The Mechanism Consists Of Motor Coupling Gear Reducer Pedestal Bearing Bridge Where The Supply Is Given To The Motor The Motor Shaft Rotates Clockwise And The Output Shaft Of Motor Is Connected To Motor Shaft Rotates Clockwise And The Output Shaft Of Motor Is Connected To Old Hams Coupling Which Connect To Msr Line Shaft And Platform Is Lifted Upward. Working Of Fabricated Stairs The Working Of Steering Is Very Easy Process In This Process Simple Rope And Pulley Mechanism Is Used And The Process Is Based On 3 Basis Principle Action Potential Energy Diameter Of Shaft Mehndi Supply Current To Single Phase Induction Motor Of Half Horsepower It Rotates At 1400 Rpm The Output Shaft Of The Motor Is Given To Speed Producer Of 1 Horsepower Which Reduces The Speed Of Motor In Its 28 Ratio And Makes It 200 At 72 Rpm The Output Shaft Of The Gear Reduces Is Given To The Wrinch Which Wind Rope Attached To The Wrinch The Other The Other End Of Rope Is Connected To The Platform And Is Passed Over The Pulley As The Brain Starts Winding The Rope The Platform Gets Lifted And The Person Gets Transported From Ground Level To First Floor. Similarly When We Reverse The Supply Of Motor Starts Rotating Anticlockwise Which Makes The Bridge To Unwind The Rope And The Platform Comes Down Slowly So That The Person Get Transported From First Floor To Ground Floor This Is . Continuous Process. The Time Taken To Lift Person Of 80 Kg Is 21.5 Seconds And That Of And That To Leave The Person Down Is 24 Seconds Which Conclude That The Rivers Action Take Much More Time Than The And That To Lift The Person Down Is 24 Seconds Which Conclude That The Rivers Action Take Much More Time Than The Forward Action.

IV. RESULTS AND DISCUSSION

There are advancements in very fields like software technology, more safety feature, and manually operated, etc. If we want to develop our country, we must have to use stair lift which should be affordable and easily operated in our Homes, Hospitals, Apartments, Old – Age Homes, etc.

Hence, we found the best way for climbing stairs through the stair lifts which is more beneficial for Old age or Handicapped people in their life. This Design of stairs with escalators (stair lift) enables the easier transporting and handling of person or a object in various places with very low price and low maintenance and can be fixed on any type of stairs. While in design if the platform is replaced by seat more comfort and safety is possible and can be used is instead of lifts in small houses

Table 1 COMPONENTS AND SPECIFICATIONS

| Sr. No | Name of Parts | Description |
|--------|-----------------|---|
| 1 | MOTOR | Spedd-1440 RPM, Single Phase Induction Motor, ½ HP Squirrel cage rotor |
| 2 | Shaft diameter | 19 mm |
| 3 | Gear box | Worm speed reducer of 1 HP, oil dipped reduction 1:20 |
| 4 | Wrench | Fabricated with M/S shaft not hardened, Rotates at 72 rpm, supported with 2 pedestal bearings |
| 5 | Wire | 4 mm diameter , steel wire rope |
| 6 | Pulley | 3 inch diameter , U-grooved pulley |
| 7 | Switch | 3 phase induction motor switch used with single phase motor, 6 poles 3 positions |
| 8 | Roller bearings | Babbitt metals Outer diameter :- 30 mm Inner diameter :- 12 mm |
| 9 | Wrench capacity | 100 kg (safe up to 90 kg load) |

FIGURES

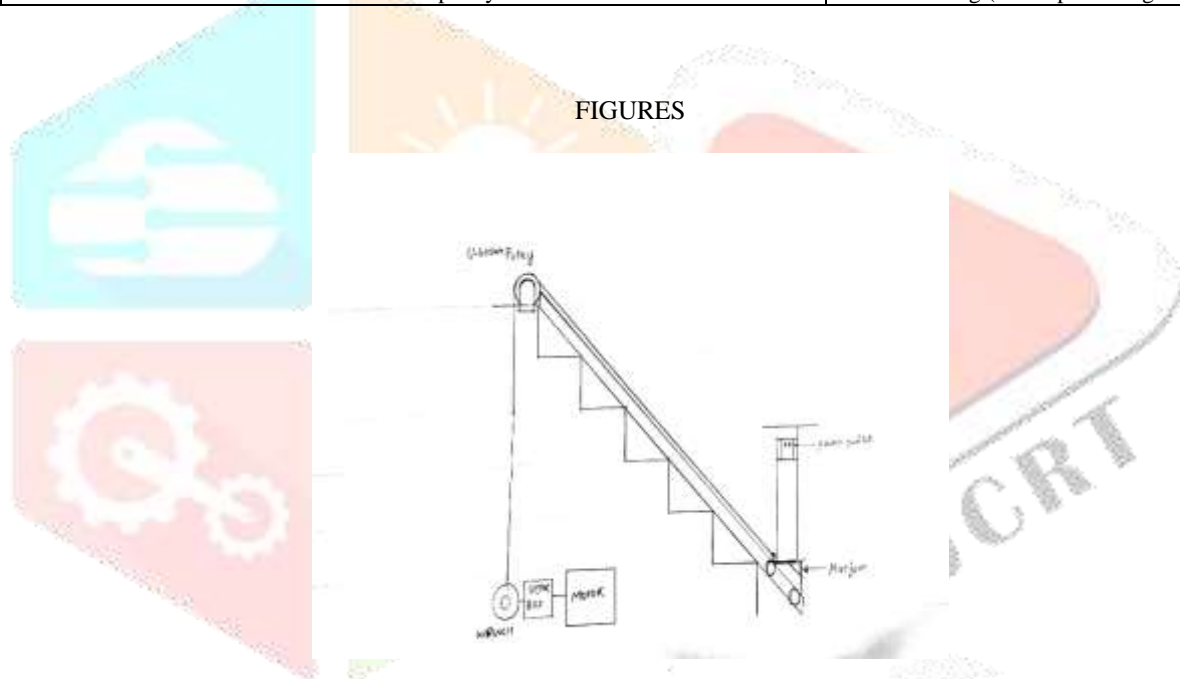


FIG 1 STRUCTURAL DESIGN

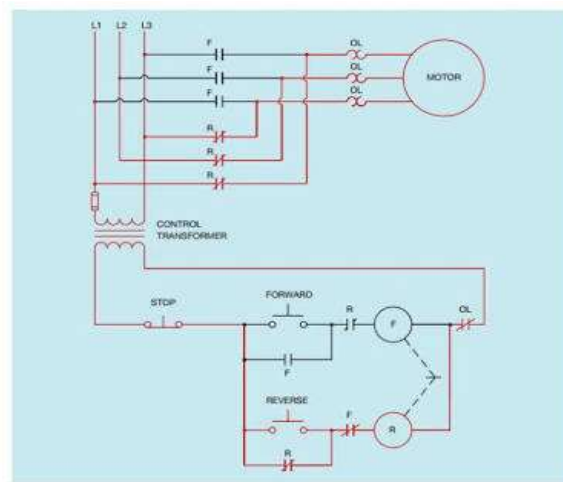


Figure 25-7 Motor operating in the reverse direction. (Source: Dehn/Cengage Learning.)

FIG 2 ELECTRICAL CIRCUIT



FIG 3 FINAL ASSEMBLY

REFERENCES

- [1] www.researchgate.net/publication/281946043 Development of an integrated staircase lift for home access
- [2] D Ding R.A Cooper "Electric-Powered Wheelchairs: A review of current technology and insight into future directions" *IEEE Control Systems Magazine*, 2005.
- [3] www.iosrjournals.org/iosr-jmce/papers/RDMEVolume5/RDME-48.pdf
- [4] Kumar, Vijay Rahman, Tariq Krovi, Venkat. (1997). *Assistive Devices For People With Motor Disabilities*.
- [5] www.thehindu.com/todays-paper/tp-features/tppropertyplus/climbing-of-stairs-is-a-breezy-affair-for-senior-citizens-now/article2640657.ece
- [6] simple.wikipedia.org/wiki/Elevator
- [7] Avinash V. Gaikwad¹ Pravin S. Ghawde² Sandip J. Kadam³, *International Journal of Innovative Research in Science, Engineering and Technology* Vol. 2, Issue7, July 2013.
- [8] .Burdick, J.W., Radford, J., and Chirikjian, G.S., *A Sidewinding Locomotion Gait for Hyper Redundant Robots*, Proc. IEEE International Conference on Robotics and Automation. 1993.