NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

MINIATURE ELEVATOR

Graduation Project
EE-400

Students: Vasviye Baltacı (20072550)
& Öner Gürbüzel (20031726)

Supervisor: Asst. Professor
Özgür C. Özerdem

Nicosia – 2008

ACKNOWLEDGEMENT

Firstly we want to thank Asst. Professor Özgür C. Özerdem to be our advisor. We are thankful to him to allow us to do this project and create this team. Under his guidance we learn lots about lifts and how to work in a team.

Another important support to us is Mr. Samet Biricik. Without him we could not be that successful. On every stage of the project, he supported us and answered all our silly questions.

We also want to thank to our sponsor Baltaci & Co Ltd and its director Mr. Ural Baltaci. They supplied all parts for us and let us to us their work place and tools.

Finally, we want to thank our parents. Without their endless love and support, none of us can achieve this position both in project and in life.

ABSTRACT

Because of the increase in population, the number of flats increases and their number of floors increases. As a result of these, lift becomes vital in most of countries.

For this reason, lift and its principles are introduced and a miniature version was created. It works same as the normal lift so by using it, some demonstrations can take place for normal size lift.

For this purpose normal size lift's parts are obtained and created a simple but functional miniature lift. When thinking on first instant, it seems easy to create a lift by combining parts but it is not. All the parts should be connected and worked simultaneously. When deciding what to use, it is needed to be very careful. It is still a developing industry so there are some missing things as well.

There are several problems during project such as when using the parts, they are designed for bigger size lift so the size of the lift was keep changed and at the end the lift become 1.60m tall which could not call miniature anymore. But overall it is a successful and useful project.

INTRODUCTION

To create a smaller version of something is not very easy. It may be more useful than bigger version but it has problems. Each part should be redesigned and every component's working ideas should take consider carefully.

We decide to design a miniature lift so new methods can be tired on it, tests can take place on it and even by changing parts with broken ones, it can be observed & tested on it.

This thesis' main aim is to show how a small lift can be created and as it is almost same working same as normal size show how a lift can be created and show working principles

The thesis consists of the introduction, two chapters and conclusion.

The chapter 1 introduces in details the principle of lift, its properties, its types and where it can be used. There is enough background information to understand further parts.

The chapter 2 studies the parts that used during the project. It gives sufficient information on parts and their working principles. Also simply explain the method which is used to place components and do the connections.

The conclusion presents contribution of the authors and practical realizations.

TABLE OF CONTENTS

1. LIFTS

1.1 History of The Lifts (Elevators):

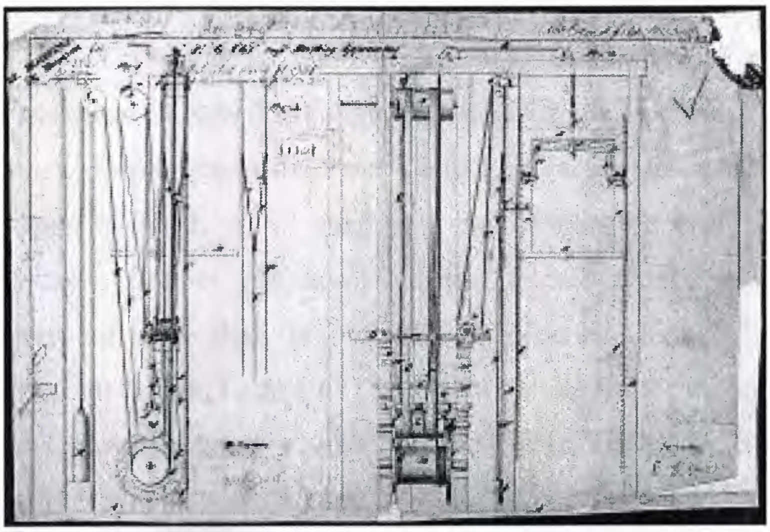

Figure 1.1: Elisha Otis' lift patent drawing, 15 January 1861.

The first reference to a lift is in the works of the Roman architect Vitruvius, who reported that Archimedes built his first lift, probably, in 236 B.C. In some literary sources of later historical periods, lifts were mentioned as cars (cabin) on a hemp rope and powered by hand or by animals. It is supposed that lifts of this type were installed in the Sinai monastery of Egypt. In the 17th century the prototypes of lifts were located in the palace buildings of England and France.

In 1793 Ivan Kulibin created a lift with the screw lifting mechanism for the Winter Palace of Saint Petersburg. In 1816 a lift was established in the main building of sub Moscow village called Arkhangelskoye. In 1823, an "ascending room" made its debut in London.

Henry Waterman of New York is credited with inventing the "standing rope control" for a lift in 1850.

In 1853, Elisha Otis introduced the safety lift, which prevented the fall of the car if the cable broke *(see figure 1)*. The design of the Otis safety lift is somewhat similar to one type still used today. A governor device engages knurled rollers; locking the lift to its guides should the lift descend at excessive speed. He demonstrated it at the New York exposition in the Crystal Palace in 1854.

On March 23, 1857 the first Otis passenger lift was installed at 488, Broadway in New York City. The first lift shaft preceded the first lift by four years. Construction for Peter Cooper's Cooper Union building in New York began in 1853. A lift shaft was included in the design for Cooper Union, because Cooper was confident that a safe passenger lift would soon be invented. The shaft was cylindrical because Cooper felt it was the most efficient design. Later Otis designed a special lift for the school. Today the Otis Lift Company, now a subsidiary of United Technologies Corporation, is the world's largest manufacturer of vertical transport systems.

The first electric lift was built by Werner von Siemens in 1880. The safety and speed of electric lifts were significantly enhanced by Frank Sprague.

The development of lifts was led by the need for movement of raw materials including coal and lumber from hillsides. The technology developed by these industries and the introduction of steel beam construction worked together to provide the passenger and freight lifts in use today.

In 1874, J.W. Meaker patented a method which permitted lift doors to open and close safely. U.S. Patent 147,853

In 1929, Clarence Conrad Crispen, with Inclinator Company of America, created the first residential lift. Crispen also invented the first inclined stair lift

1.2 First Designs:

Lifts began as simple rope or chain hoists. A lift is essentially a platform that is either pulled or pushed up by a mechanical means. A modern day lift consists of a car (also called a "cage" or "cab") mounted on a platform within an enclosed space called a shaft, or in Commonwealth countries called a "hoist way". In the past, lift drive mechanisms were powered by steam and water hydraulic pistons. 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 weight of the car is balanced with a counterweight. Sometimes two lifts always move synchronously in opposite directions, and they are each other's counterweight.

The friction between the ropes and the pulley furnishes the traction which gives this type of lift its name.

Hydraulic lift uses the principles of hydraulics to pressurise an above ground or in-ground piston to raise and lower the car. Roped Hydraulics use a combination of both ropes and hydraulic power to raise and lower cars. Recent innovations include permanent earth magnet motors, machine room-less rail mounted gearless machines, and microprocessor controls.

Which technology is used in new installations depends on a variety of factors. Hydraulic lifts are cheaper, but installing cylinders greater than a certain length becomes impractical for very high lift hoistways. For buildings of much over seven floors, traction lift must be employed instead. Hydraulic lifts are usually slower than traction lifts and the oil need to cool down when travelling longer distances.

Lifts are a candidate for mass customisation. There are economies to be made from mass production of the components, but each building comes with its own requirements like different number of floors, dimensions of the well and usage patterns.

1.3 Uses of Lifts

1.3.1 Passenger Service

A passenger lift is designed to move people between a building's floors. Passenger lifts capacity is related to the available floor space. Generally passenger lifts are available in capacities from 450 to 2,727 kg (1,000 to 6,000 lb) in 230 kg (500 lb) increments. Generally passenger lifts in buildings eight floors or less are hydraulic or electric, which can reach speeds up to 1.0 m/s (200 ft/min) hydraulic and up to 2.5 m/s (500 ft/min) electric. In buildings up to ten floors, electric and gearless lifts are likely to have speeds up to 2.5 m/s (500 ft/min), and above ten floors speeds begin at 2.5 m/s (500 ft/min) up to 10 m/s (2000 ft/min).

Sometimes passenger lifts are used as a city transport along with funiculars. For example, there is a 3-station underground public lift in Yalta, Ukraine, which takes passengers from the top of a hill above the Black Sea on which hotels are perched, to a tunnel located on the beach below.

1.3.1.1 Types of Passenger Lifts

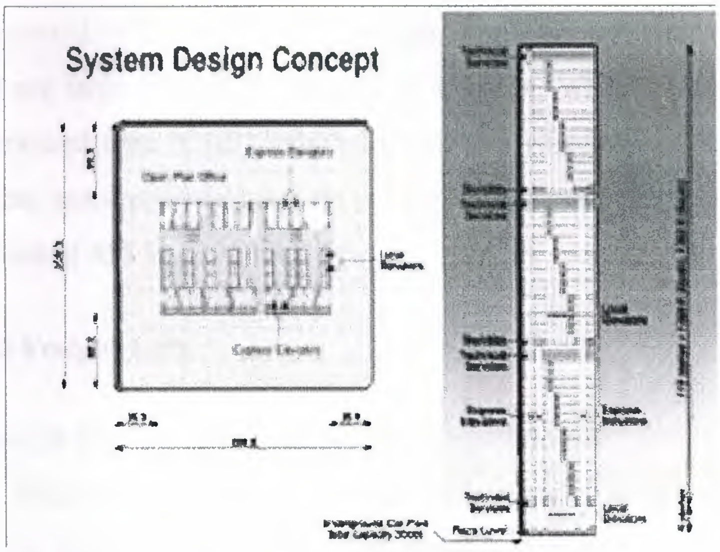

Figure 1.2: The former Centre's twin towers used sky lobbies, located on the 44th and 78th floors of each tower.

Passenger lifts may be specialized for the service they perform, including: Hospital emergency (Code blue), front and rear entrances, double decker and other uses. Cars may be ornate in their interior appearance, may have audio visual advertising, and may be provided with specialized recorded voice instructions.

An express lift does not serve all floors. For example, it moves between the ground floor and a skylobby, or it moves from the ground floor or a skylobby to a range of floors, skipping floors in between.

1.3.1.2 Entrapment

All lifts are required to have communication connection to an outside 24 hour emergency service, automatic recall capability in a fire emergency, and special access for fire fighters' use in a fire. Lifts should not be used by the public if there is a fire in or around the building, and as such numerous building codes require signs near the lift to state as much. However, emergency evacuations in some countries do allow the use of special 'fire lifts'.

1.3.1.3 Capacity

Residential lifts may be small enough to only accommodate one person while some are large enough for more than a dozen. Wheelchair, or platform lifts, a specialized type of lift designed to move a wheelchair 1.8 m (6 ft) or less, often can accommodate just one person in a wheelchair at a time with a maximum load of 455 kg (1000 lb).

1.3.2 Freight Lifts

A freight lift (or goods lift) is a lift designed to carry goods, rather than passengers. Freight lifts are often exempt from some code requirements and from some of the requirements for fire service. However, new installations would likely be required to comply with these requirements. Freight lifts are generally required to display a written notice in the car that the use by passengers is prohibited, though certain freight lifts allow dual use through the use of an inconspicuous riser. Freight lifts are typically larger and capable of carrying heavier loads than a passenger lift, generally from 2,300 to 4,500 kg. Freight lifts may have manually operated doors and often have rugged interior finishes to prevent damage while loading and unloading. Although hydraulic freight lifts exist, electric lifts are more energy efficient for the work of freight lifting.

1.3.3 Vehicle Lifts

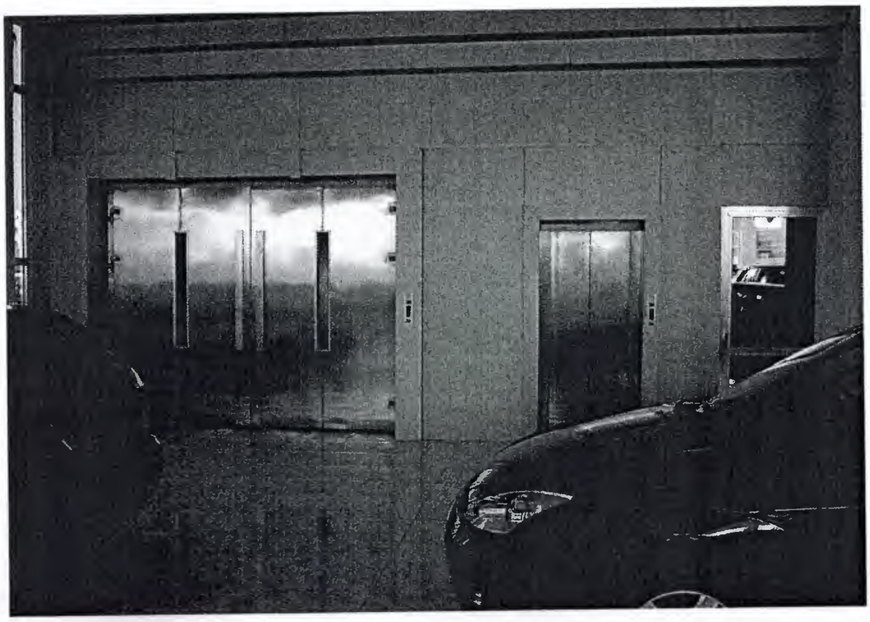

Figure 1.3: a vehicle lift in a local car shop

A car lift is installed where ramps are considered space-inconservative for smaller buildings (usually in apartment buildings where frequent access is not an issue). The car platforms are raised and lowered hydraulically and are connected to chained steel gears (resembling bicycle chains in appearance). In addition to the vertical motion, the platforms can rotate about its vertical axis (up to 180 degrees) to ease driver access and/or accommodate building plans. Most parking lots of this type cannot accommodate tall or heavy vehicles, like SUVs.

1.3.4 Boat Lifts

In some smaller canals, boats and small ships can pass between different levels of a canal with a boat lift rather than through a canal lock.

1.3.5 Aircraft Lifts

Figure 1.4: An F/A-18C on an aircraft lift of the USS Kitty Hawk

On aircraft carriers, lifts carry aircraft between the flight deck and the hangar deck for operations or repairs. These lifts are designed for much greater capacity than any other lift ever built, up to 200,000 pounds of aircraft and equipment. Smaller lifts lift munitions to the flight deck from magazines deep inside the ship.

1.3.6 Dumbwaiter

A small freight lift is often called a dumbwaiter, often used for the moving of small items such as dishes in a 2-story kitchen or books in a multi-story rack assembly. Passengers are never permitted on dumbwaiters.

Modern dumbwaiters are generally driven by a small electric motor with a counterweight and their capacity is limited to about 340 kg (750 lb). Dumbwaiters are used extensively in the restaurant business and may also be used as book lifts in libraries or to transport mail or similar items in an office tower. These dumbwaiters can withstand heavy loads of up to 200 kg.

Dumbwaiters, especially older ones, may also be hand operated using a roped pulley, and they are often found in Victorian-era houses, offices and other establishments constructed when such devices were at their peak.

1.3.7 Paternoster

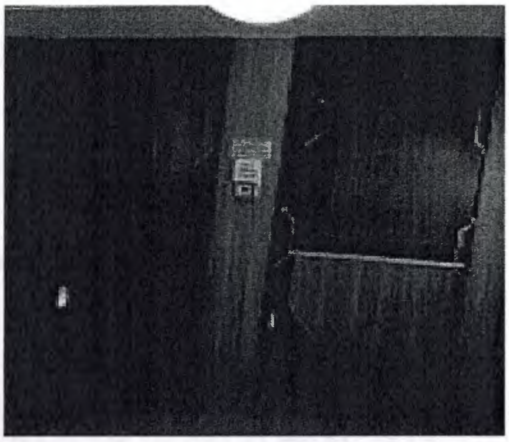

Figure 1.5: A paternoster in Berlin from the 1970s

A special type of lift is the paternoster, a constantly moving chain of boxes. A similar concept moves only a small platform, which the rider mounts while using a handhold and was once seen in multi-story industrial plants.

1.3.8 Material Handling Belts and Belt Lifts

A different kind of lift is used to transport material. It generally consists of an inclined plane on which a conveyor belt runs. The conveyor often includes partitions to prevent the material from sliding backwards. These lifts are often used in industrial and agricultural applications. When such mechanisms (or spiral screws or pneumatic transport) are used to elevate grain for storage in large vertical silos, the entire structure is called a grain lift.

There have occasionally been lift belts for humans; these typically have steps about every seven feet along the length of the belt, which moves vertically so that the passenger can stand on one step and hold on to the one above. These belts are sometimes used to carry the employees of parking garages, but are considered too dangerous for public use.

1.4 Types of Lift Hoist Mechanisms

In general, there are three means of moving a lift:

a. Traction lifts
b. Hydraulic lifts
c. Climbing lift

1.4.1 Traction Lifts

- ***Geared and gearless traction lifts***

Geared Traction machines are driven by AC or DC electric motors. Geared machines use worm gears to control mechanical movement of lift cars by "rolling" steel hoist ropes over a drive sheave which is attached to a gearbox driven by a high speed motor. These machines are generally the best option for basement or overhead traction use for speeds up to 2.5 m/s (500 ft/min).

Gearless Traction machines are low speed (low RPM), high torque electric motors powered mainly by AC or DC. In this case, the drive sheave is directly attached to the end of the motor. Gearless traction lifts can reach speeds of up to 10 m/s (2,000 ft/min), or even higher. A brake is mounted between the motor and drive sheave (or gearbox) to hold the lift stationary at a floor. This brake is usually an external drum type and is actuated by spring force and held open electrically; a power failure will cause the brake to engage and prevent the lift from falling.

In each case, cables are attached to a hitch plate on top of the car or may be underslung below a car and then looped over the drive sheave to a counterweight attached to the opposite end of the cables which reduces the amount of power needed to move the car. The counterweight is located in the hoist-way and rides a separate rail system; as the car goes up, the counterweight goes down, and vice versa. This action is powered by the traction machine which is directed by the controller, typically a relay logic or computerized device that directs starting, acceleration, deceleration and stopping of the lift car. The weight of the counterweight is typically equal to the weight of the lift car plus 40-50% of the capacity of the lift. The grooves in the drive sheave are specially designed to prevent the cables from slipping. Traction is provided to the ropes by the grip of the grooves in the sheave, thereby the name. As the ropes age and the traction grooves wear, some traction is lost and the ropes must be replaced and the sheave repaired or replaced.

Lifts with more than 100' of travel have a system called compensation. This is a separate set of cables or a chain attached to the bottom of the counterweight and the bottom of the lift car. This makes it easier to control the lift, as it compensates for the differing weight of cable between the hoist and the car. If the lift car is at the top of the hoist-way, there is a short length of hoist cable above the car and a long length of compensating cable below the car and vice versa for the counterweight. If the compensation system uses cables, there will be an additional sheave in the pit below the lift, to guide the cables. If the compensation system uses chains, the chain is guided by a bar mounted between the counterweight rails.

1.4.2 Hydraulic Lifts

There are mainly four types of hydraulic lifts.

a. *Conventional Hydraulic* lifts were first developed by Dover Lift (now ThyssenKrupp Lift). They are quite common for low and medium rise buildings (2-8 floors), attain speeds of up to 1.0 m/s (200 feet/minute), and use a hydraulically powered plunger to push the lift upwards. On some, the hydraulic piston (plunger) consists of telescoping concentric tubes, allowing a shallow tube to contain the mechanism below the lowest floor. On others, the piston requires a deeper hole below the bottom landing, usually with a PVC casing (also known as a caisson) for protection.

b. *Roped hydraulic* lifts use a combination of ropes and hydraulics.

c. *Twin post hydraulic* provides higher travel with no underground hole.

d. *Holeless hydraulic* lifts do not require holes to be dug for the hydraulic cylinder. In most designs, the car is lifted by a pair of hydraulic jacks, one on each side of the lift.

1.4.3 Climbing Lift

A climbing lift is a self-ascending lift with its own propulsion. The propulsion can be done by an electric or a combustion engine. Climbing lifts are used in guyed masts or towers, in order to make easy access to parts of these constructions, such as flight safety lamps for maintenance. An example would be the Moonlight towers in Austin, Texas, where the lift holds only one person and equipment for maintenance.

1.5 Controlling Lifts

1.5.1 General Controls

Figure 1.6: A lift buttons made by Dover/ThyssenKrupp (with no thirteenth floor): A modern lift has buttons to allow passengers to select the desired floor.

A typical modern passenger lift will have:

- Call buttons to choose a floor. Some of these may be key switches (to control access). In some lifts, certain floors are inaccessible unless one swipe a security card or enters a pass code (or both). In the Europe and other countries, call button text and icons are raised to allow blind users to operate the lift; many have Braille text besides.
- Door open and door close buttons to instruct the lift to close immediately or remain open longer. In some lifts, holding the door open for too long will trigger an audible alarm.
- A stop switch (not allowed under British regulations) to halt the lift is often used to hold a lift open while freight is loaded. Keeping a lift stopped for too long may trigger an alarm. Often, this will be a key switch.
- An alarm button or switch, which passengers can use to signal that they have been trapped in the lift.

Some lifts may have one or more of the following:

- A lift telephone, which can be used (in addition to the alarm) by a trapped passenger to call for help.
- A fireman's key switch, which places the lift in a special operating mode designed to aid fire-fighters.
- A medical emergency key switch, which places the lift in a special operating mode designed to aid medical personnel.
- Hold button: This button delays the door closing timer, useful for loading freight and hospital beds.
- Call Cancellation: A destination floor may be deselected by double clicking.
- RFID card reader, a security mechanism that enables the destination buttons only when an authorized security tag is detected.

Other controls, which are generally inaccessible to the public (either because they are key switches or because they are kept behind a locked panel), include:

- Switches to control the lights and ventilation fans in the lift.
- An inspector's switch, which places the lift in inspection mode (this may be situated on top of the lift)
- An independent service/Exclusive Mode will prevent the car from answering to hall calls and only arrive the selected floors in the panel. The door should stay open while parked on a floor. This mode may be used for temporarily transporting goods.
- Up and down buttons, to move the car until the buttons are released.
- Pass button, causes the car to temporarily ignore car calls while in motion. This is usually located inside the keyed panel and used in service lifts. However, this feature is automatically activated when the lift is full.
- Start button - in serviced lifts, the car answers calls but the lift holds the door open until the Start button is pressed.

1.5.2 Controls in early lifts

Figure 1.7: Manual pushbutton lift controls.

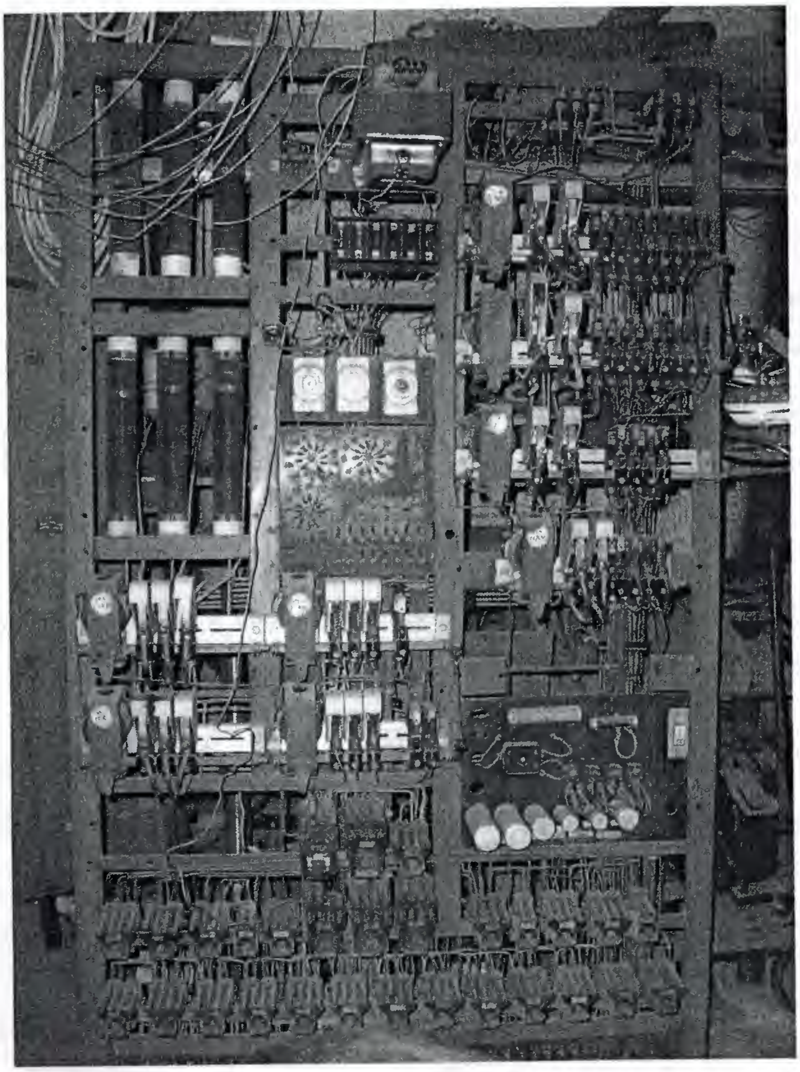

Figure 1.8: Control panel of an old lift

Some older freight lifts are controlled by switches operated by pulling on adjacent ropes. Safety interlocks ensure that the inner and outer doors are closed before the lift is allowed to move.

Early lifts had no automatic landing positioning. Lifts were operated by lift operators using a motor controller. The controller was contained within a cylindrical container about the size and shape of a cake container and this was operated via a projecting handle. This allowed some control over the energy supplied to the motor located at the top of the lift shaft or beside the bottom of the lift shaft and so enabled the lift to be accurately positioned, if the operator was sufficiently skilled. More typically the operator would have to jog the control to get the lift reasonably close to the landing point and then direct the outgoing and incoming passengers to watch the step. After stopping at the landing the operator would open the door. Some slightly later lifts though, had door that could be operated by the same control so when the lever is moved in the desired direction, between the idle and motion points there is a trigger to close the doors. When the handle is moved to idle, the doors open again. This sort of arrangement was used sometimes in subway stations. Manually operated lifts were generally refitted or the cars replaced by automatic equipment by the 1950s. The major exception is freight lifts which today are just as common to be manually operated or have automatic operation, and even when equipped with automatic controls, they are often operated by an attendant to ensure efficiency.

Early automatic lifts used relays as logic gates to control them, which began to be replaced by microprocessors from the late 1980s. *(See figure 7)*

Large buildings with multiple lifts of this type would also have a lift dispatcher stationed in the lobby to direct passengers and to signal the operator to leave with the use of a mechanical cricket noisemaker. Some lifts still in operation have pushbutton manual controls.

1.5.3 External Controls

Lifts are typically controlled from the outside by up and down buttons at each stop. When pressed at a certain floor, the lift arrives to pick up more passengers. If the said lift is currently serving traffic in a certain direction, it will only answer hall calls in the same direction unless there are no more calls beyond that floor.

In a group of two or more lifts, the call buttons may be linked to a central dispatch computer, such that they illuminate and cancel together. This is done to ensure that only one car is called at one time.

Key switches may be installed on the ground floor so that the lift can be remotely switched on or off from the outside.

1.5.4 The Lift Algorithm

The lift algorithm, a simple algorithm by which a single lift can decide where to stop, is summarized as follows:

- Continue travelling in the same direction while there are remaining requests in that same direction.
- If there are no further requests in that direction, then stop and become idle, or change direction if there are requests in the opposite direction.

The lift algorithm has found an application in computer operating systems as an algorithm for scheduling hard disk requests. Modern lifts use more complex heuristic algorithms to decide which request to service next.

1.5.5 Computer Dispatched

Efficiencies of multiple lifts installed in an office building may increase if a central dispatcher is used to group passengers going to the same floor to the same lift. In the industry, this is known as the 'Destination floor control system'. In buildings with these computer-dispatched lift systems, passenger key in their destination floor in a central dispatch panel located at the building lobby. The dispatch panel will then tell the passenger which lift to use. Inside the lift there is no call button to push or the buttons are there but they cannot be pushed, they only indicate stopping floors. The system was first pioneered by Schindler Lift as the Miconic 10. Manufacturers of such systems claim that average travelling time can be reduced by up to 30%. There are some problems with the system though. Sometimes, one person enters the destination for a large group of people going to the same floor. The dispatching algorithm is usually unable to completely cater for the variation, and late comers may find the lift they are assigned to be already full. Also, occasionally, one person may press the floor multiple times. This is common with up/down buttons when people believe this to hurry lifts. However, this will make the computer think multiple people are waiting and will allocate empty cars to serve this one person.

1.5.6 Special Operating Modes

1.5.6.1 Up Peak

During Up Peak mode, lift cars in a group are recalled to the lobby to provide expeditious service to passengers arriving at the building, most typically in the morning as people arrive for work or at the conclusion of a lunch-time period. Lifts are dispatched one-by-one when they reach a pre-determined passenger load or when they have had their doors opened for a certain period of time. The next lift to be dispatched usually has its hall lantern or a "this car leaving next" sign illuminated to encourage passengers to make maximum use of the available lift system capacity.

The commencement of Up Peak may be triggered by a time clock, by the departure of a certain number of fully loaded cars leaving the lobby within a given time period, or by a switch manually operated by a building attendant.

1.5.6.2 Down Peak

During Down Peak mode, lift cars in a group are sent away from the lobby towards the highest floor served, after which they commence running down the floors in response to hall calls placed by passengers wishing to leave the building. This allows the lift system to provide maximum passenger handling capacity for people leaving the building.

The commencement of Down peak may be triggered by a time clock, by the arrival of a certain number of fully loaded cars at the lobby within a given time period, or by a switch manually operated by a building attendant.

1.5.6.3 Sabbath Service

In areas with large populations of observant Jews, one may find a "Sabbath lift". In this mode, a lift will stop automatically at every floor, allowing people to step on and off without having to press any buttons. This prevents violation of the Sabbath prohibition against operating electrical devices when sabbath is in effect for those who observe this ritual.

1.5.6.4 Independent Service

Independent service is a special service mode found on most lifts. It is activated by a key switch either inside the lift itself or on a centralized control panel in the lobby. When a lift is placed on independent service, it will no longer respond to hall calls. In a bank of lifts, traffic would be rerouted to the other lifts, while in a single lift; the hall buttons will be disabled. The lift will remain parked on a floor with its doors open until a floor is selected and the door close button is held until the lift starts to travel. Independent service is useful when transporting large goods or moving groups of people between certain floors.

1.5.6.5 Inspection Service

Inspection service is designed to provide access to the hoistway and car top for inspection and maintenance purposes by qualified lift mechanics. It is first activated by a key switch on the car operating panel usually labelled 'Inspection', 'Car Top', 'Access Enable' or 'HWENAB'. When this switch is activated the lift will come to a stop if moving, car calls will be cancelled and the buttons disabled, and hall calls will be assigned to other lift cars in the group or cancelled in a single lift configuration. The lift can now only be moved by the corresponding 'Access' key switches, usually located at the top-most (to access the top of the car) and bottom-most (to access the lift pit) landings. The access key switches will bypass the door lock circuit for the floor it is located on and allow the car to move at reduced inspection speed with the hoistway door open. This speed can range from anywhere up to 60% of normal operating speed on most controllers, and is usually defined by local safety codes.

Lifts have a car top inspection station that allows the car to be operated by a mechanic in order to move it through the hoistway. Generally, there are three buttons - UP, RUN, and DOWN. Both the RUN and a direction button must be held to move the car in that direction, and the lift will stop moving once one of the buttons is no longer being pressed for safety reasons. The inspection station is usually also equipped with a light, alarm button and stop switch.

1.5.6.6 Fire Service Mode

Depending on the location of the lift, fire service code will vary state to state and country to country. Fire service is usually split up into two modes. Phase one and Phase Two are separate modes that the lift can go into.

Phase one mode is activated by a corresponding smoke sensor or heat sensor in the building. Once an alarm has been activated, the lift will automatically go into phase one. The lift will wait an amount of time, and then proceed to go into nudging mode to tell everyone the lift is leaving the floor. Once the lift has left the floor, depending on where the alarm was set off, the lift will go to the Fire Recall Floor. However, if the alarm was activated on the fire recall floor the lift will have an alternate floor to recall to. When the lift is recalled, it proceeds to the recall floor and stops with its doors open. The lift will no longer respond to calls or move in any direction. Located on the fire recall floor is a fire service key switch. The fire service key switch has the ability to turn fire service off, turn fire service on or to bypass fire service. The only way to return the lift to normal service is to switch it to bypass after the alarms have reset.

Phase two mode can only be activated by a key switch located inside the lift on the centralized control panel. This mode was created for fire-fighters so that they may rescue people from a burning building. The phase two key switches located on the COP has three positions: off, on, and hold. By turning phase two on, the fire-fighter enables the car to move. However, like independent service mode, the car will not respond to a car call unless the fire-fighter manually pushes and holds the door close button. Once the lift gets to the desired floor it will not open its doors unless the fire-fighter holds the door open button. This is in case the floor is burning and the fire-fighter can feel the heat and knows not to open the door. The fire-fighter must hold door open until the door is completely opened. If for any reason the fire-fighter wishes to leave the lift, they will use the hold position on the key switch to make sure the lift remains at that floor. If the fire-fighter wishes to return to the recall floor, they simply turn the key off and close the doors.

1.5.6.7 Medical Emergency/'Code Blue' Service

Commonly found in hospitals, Code Blue service allows a lift to be summoned to any floor for use in an emergency situation. Each floor will have a 'Code Blue' recall key switch, and when activated, the lift system will immediately select the lift car that can respond the fastest, regardless of direction of travel and passenger load. Passengers inside the lift will be notified with an alarm and indicator light to exit the lift when the doors open.

Once the lift arrives at the floor, it will park with its doors open and the car buttons will be disabled to prevent a passenger from taking control of the lift. Medical personnel must then activate the Code Blue key switch inside the car, select their floor and close the doors with the door close button. The lift will then travel non-stop to the selected floor, and will remain in Code Blue service until switched off in the car. Some hospital lifts will feature a 'hold' position on the Code Blue key switch (similar to fire service) which allows the lift to remain at a floor locked out of service until Code Blue is deactivated.

1.5.6.8 Emergency Power Operation

Many lift installations now feature emergency power systems which allow lift use in blackout situations and prevent people from becoming trapped in lifts.

Traction lifts:

When power is lost in a traction lift system, all lifts will initially come to a halt. One by one, each car in the group will return to the lobby floor, open its doors and shut down. People in the remaining lifts may see an indicator light or hear a voice announcement informing them that the lift will return to the lobby shortly. Once all cars have successfully returned, the system will then automatically select one or more cars to be used for normal operations and these cars will return to service. The car(s) selected to run under emergency power can be manually overridden by a key or strip switch in the lobby. In order to help prevent entrapment, when the system detects that it is running low on power, it will bring the running cars to the lobby or nearest floor, open the doors and shut down.

Hydraulic lifts

In hydraulic lift systems, emergency power will lower the lifts to the lowest landing and open the doors to allow passengers to exit. The doors then close after an adjustable time period and the car remains unusable until reset, usually by cycling the lift main power switch. Typically, due to the high current draw when starting the pump motor, hydraulic lifts aren't run using standard emergency power systems. Buildings like hospitals and nursing homes usually size their emergency generators to accommodate this draw. However, the increasing use of current limiting motor starters, commonly known as "Soft-Start" contactors, avoid much of this problem and the current draw of the pump motor is less of a limiting concern.

2. METHODOLOGY

In this project a miniature lift was designed. All the parts that used are real parts of a normal size lift only motor is special because the weight it will carry and travelling speed of the miniature lift is much lesser than normal size lift.

2.1 Parts:

Parts that used for control panel:

- 2 x Finder Contactor Relay 10A 250V
- 5 x Kuhnke Relay 24 VDC
- 1 x Transformer 240 V
- 1 x Bridge Rectifier 12 VDC
- 1 x Bridge Rectifier 24 VDC
- 1 x Siemens MCB
- 2 x Kangyu MCB

Other tools:

- 1 x Motor 24 VDC
- 6 x Magnetic Tube
- Four magnets
- Metal for car and frame

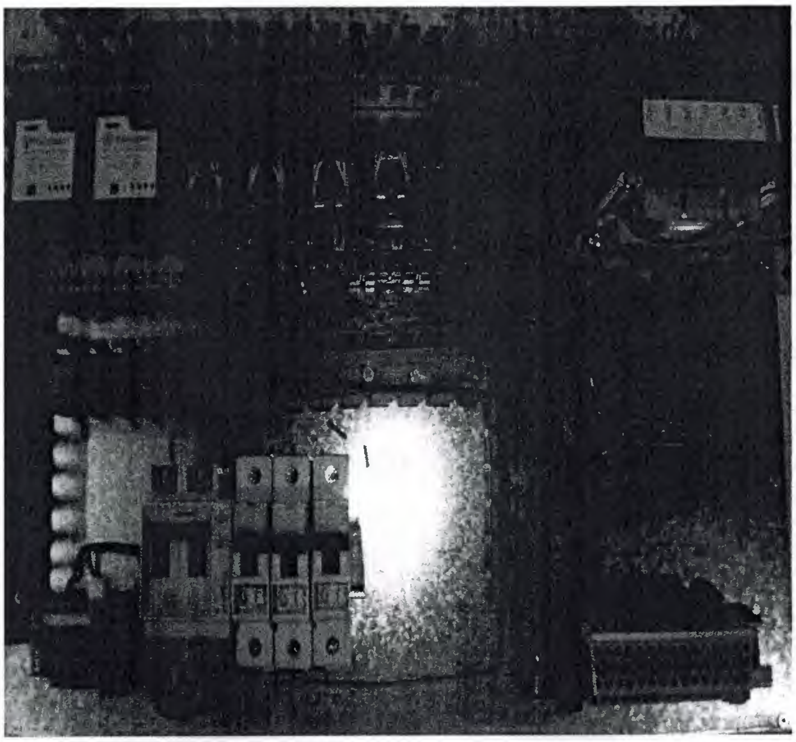

Figure 2.1: While placing components

2.1.1 Relay:

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

When a current flows through the coil, the resulting magnetic field attracts an armature that is mechanically linked to a moving contact. The movement either makes or breaks a connection with a fixed contact. When the current to the coil is switched off, the armature is returned by a force approximately half as strong as the magnetic force to its relaxed position. Usually this is a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a spike of voltage and might cause damage to circuit components. Some automotive relays already include that diode inside the relay case. Alternatively a contact protection network, consisting of a capacitor and resistor in series, may absorb the surge. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

Since relays are switches, the terminology applied to switches is also applied to relays. A relay will switch one or more poles, each of whose contacts can be thrown by energizing the coil in one of three ways:

- Normally-open (**NO**) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a **Form A** contact or "make" contact.
- Normally-closed (**NC**) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a **Form B** contact or "break" contact.
- Change-over, or double-throw, contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called a **Form C** contact or "transfer" contact. If this type of contact utilises “make before break” functionality, then it is called a **Form D** contact.

First type that used in the project is a Contactor Relay

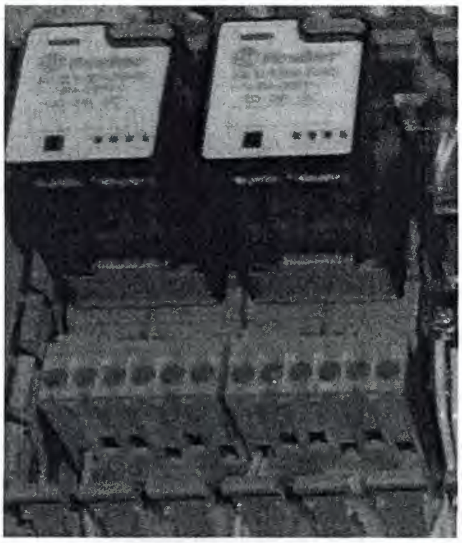

Figure 2.2: Contactor Relay

The main aim of these contactor relay in our project is to give directions to the lift i.e. it is the part which make lift goes up and down. When a passenger press a button which will direct the lift, for example, to go up then the first contactor relay magnetise, pull the contact and allow the current flow; then the lift car start moving up. When it reaches the floor, it un-magnetises and stops the current floor by opening the contact and so the lift car stops. Same happen when moving down as well.

Second type relays that used are;

Figure 2.3: Relays

In the project initial two relays are used to provide support to contactor relay as they need more ports. They work parallel. Final three relays are for ground, first and second floors control. It has the same idea as contactor relays.

2.1.2 Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled electrical conductors. A changing current in the first circuit (the primary) creates a changing magnetic field; in turn, this magnetic field induces a changing voltage in the second circuit (the secondary). By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other.

The secondary induced voltage V_S, of an ideal transformer, is scaled from the primary V_P by a factor equal to the ratio of the number of turns of wire in their respective windings:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up, by making N_S more than N_P, or stepped down, by making it less.

Transformers are some of the most efficient electrical machines, with some large units able to transfer 99.75% of their input power to their output. Transformers come in a range of sizes from a thumbnail-sized coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of national power grids. All operate with the same basic principles, though a variety of designs exist to perform specialised roles throughout home and industry.

A key application of transformers is to increase voltage before transmitting electrical energy over long distances through wires. Most wires have resistance and so dissipate electrical energy at a rate proportional to the square of the current through the wire. By transforming electrical power to a high-voltage form for transmission and back again afterwards, transformers enable economic transmission of power over long distances. Consequently, transformers have shaped the electricity supply industry, permitting generation to be located remotely from points of demand. A fraction of the world's electrical power has passed through a series of transformers by the time it reaches the consumer. Transformers are used extensively in consumer electronic products to step down the supply voltage to a level suitable for the low voltage circuits they contain. In these kinds of applications the transformer may also act as a key safety component that electrically isolates the end user from direct contact with the potentially lethal supply voltage.

The transformer is based on two principles: firstly that an electric current can produce a magnetic field (electromagnetism) and secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). By changing the current in the primary coil, it changes the strength of its magnetic field; since the changing magnetic field extends into the secondary coil, a voltage is induced across the secondary.

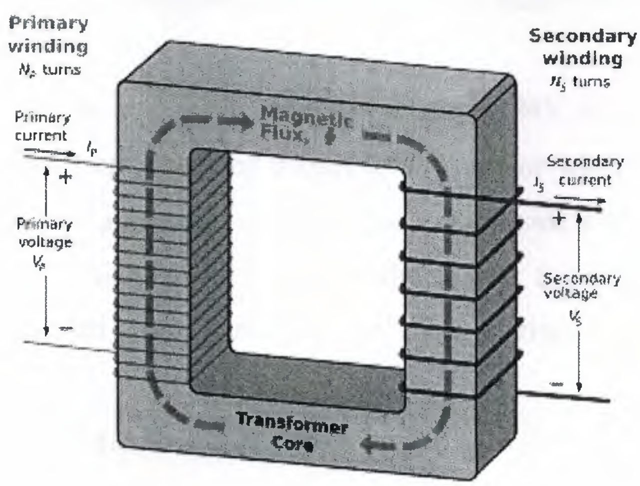

Figure 2.4: An ideal step-down transformer showing magnetic flux in the core

A simplified transformer design is shown above. A current passing through the primary coil creates a magnetic field. The primary and secondary coils are wrapped around a core of very high magnetic permeability, such as iron; this ensures that most of the magnetic field lines produced by the primary current are within the iron and pass through the secondary coil as well as the primary coil.

The transformer that is used in this project is a step down transformer;

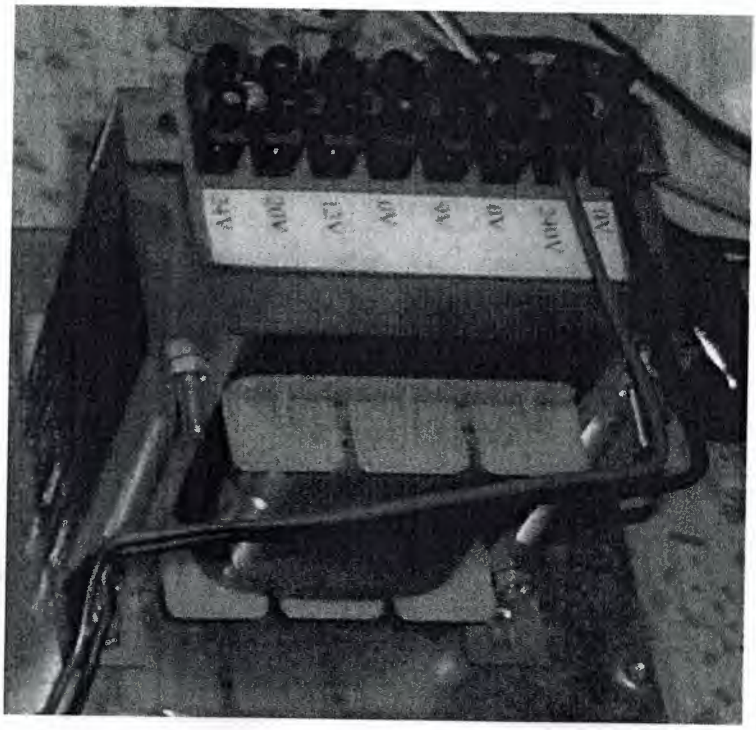

Figure 2.5 Transformer used for control panel circuit

Its aim in the project is to supply 24V to the motor. It gets 240V from mains, step down and supply 24V to motor which is max voltage output this type of transformer can give. Its primary side's 0V and 240V is connected to MCB which is connected to the mains. Secondary side's 0V and 24V is connected to bridge rectifier to fix the polarities.

2.1.3 Bridge Rectifier

A diode bridge or bridge rectifier is an arrangement of four diodes connected in a bridge circuit, that provides the same polarity of output voltage for any polarity of the input voltage. When used in its most common application, for conversion of alternating current (AC) input into direct current (DC) output, it is known as a bridge rectifier. The bridge rectifier provides full wave rectification from a two wire AC input (saving the cost of a center tapped transformer) but has two diode drops rather than one reducing efficiency over a center tap based design for the same output voltage.

When the input connected at the left corner of the diamond is positive with respect to the one connected at the right hand corner, current flows to the right along the upper colored path to the output, and returns to the input supply via the lower one. (see figure 2.6)

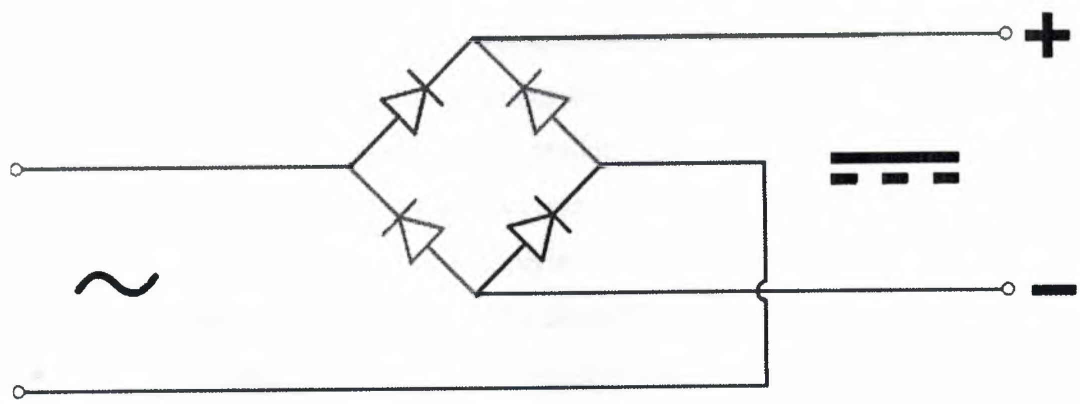

Figure 2.6: Rectifier bridge

When the right hand corner is positive relative to the left hand corner, current flows along the upper colored path and returns to the supply via the lower colored path. (see figure 2.7)

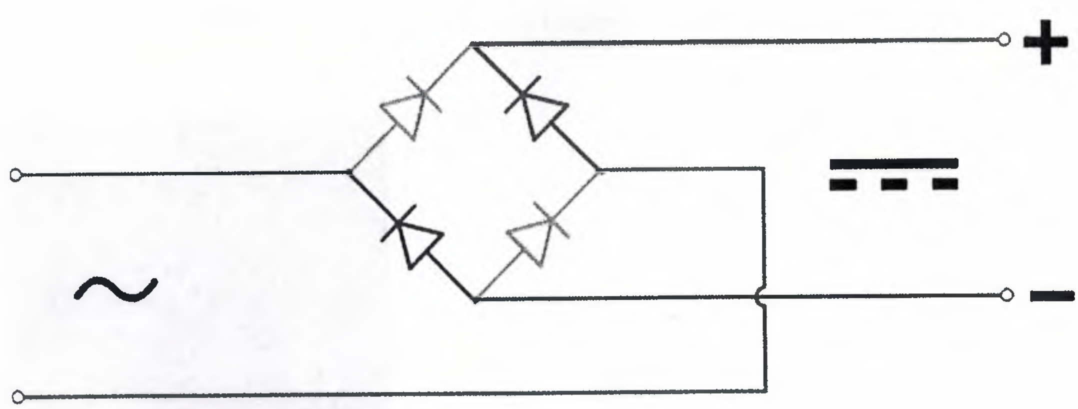

Figure 2.7: Rectifier bridge

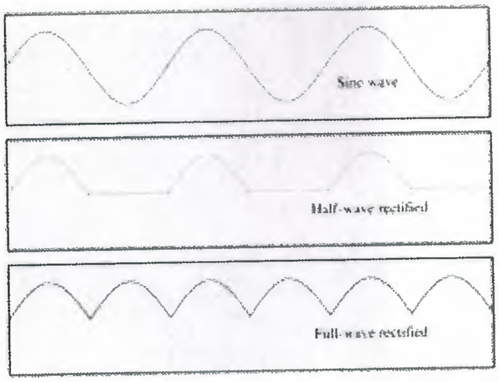

Figure 2.8: AC, half-wave and full wave rectified signals

In each case, the upper right output remains positive with respect to the lower right one. Since this is true whether the input is AC or DC, this circuit not only produces DC power when supplied with AC power: it also can provide what is sometimes called "reverse polarity protection". That is, it permits normal functioning when batteries are installed backwards or DC input-power supply wiring "has its wires crossed" (and protects the circuitry it powers against damage that might occur without this circuit in place).

Prior to availability of integrated electronics, such a bridge rectifier was always constructed from discrete components. Since about 1950, a single four-terminal component containing the four diodes connected in the bridge configuration became a standard commercial component and is now available with various voltage and current ratings.

During the project there following bridge rectifiers were used.

Figure 2.9: rectifier diode 12 VDC used for project

Figure 2.10: rectifier diode 24 VDC used for project

Their function in the circuit is to arrange polarities of the 240V input voltage and 24V output voltage of the transformer.

2.1.4 MCB (Circuit Breaker)

A circuit breaker is an automatically-operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset, either manually or automatically, to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city.

All circuit breakers have common features in their operation, although details vary substantially depending on the voltage class, current rating and type of the circuit breaker.

The circuit breaker must detect a fault condition; in low-voltage circuit breakers this is usually done within the breaker enclosure. Circuit breakers for large currents or high voltages are usually arranged with pilot devices to sense a fault current and to operate the trip opening mechanism. The trip solenoid that releases the latch is usually energized by a separate battery, although some high-voltage circuit breakers are self-contained with current transformers, protection relays, and an internal control power source.

Once a fault is detected, contacts within the circuit breaker must open to interrupt the circuit; some mechanically stored energy within the breaker is used to separate the contacts, although some of the energy required may be obtained from the fault current itself. The stored energy may be in the form of springs or compressed air. Small circuit breakers may be manually operated; larger units have solenoids to trip the mechanism, and electric motors to restore energy to the springs.

The circuit breaker contacts must carry the load current without excessive heating, and must also withstand the heat of the arc produced when interrupting the circuit. Contacts are made of copper or copper alloys, silver alloys, and other materials. Service life of the contacts is limited by the erosion due to interrupting the arc. Miniature circuit breakers are usually discarded when the contacts are worn, but power circuit breakers and high-voltage circuit breakers have replaceable contacts.

When a current is interrupted, an arc is generated - this arc must be contained, cooled, and extinguished in a controlled way, so that the gap between the contacts can again withstand the voltage in the circuit. Different circuit breakers use vacuum, air, insulating gas, or oil as the medium in which the arc forms. Different techniques are used to extingish the arc including:

- Lengthening of the arc
- Intensive cooling (in jet chambers)
- Division into partial arcs
- Zero point quenching
- Connecting capacitors in parallel with contacts in DC circuits

Finally, once the fault condition has been cleared, the contacts must again be closed to restore power to the interrupted circuit.

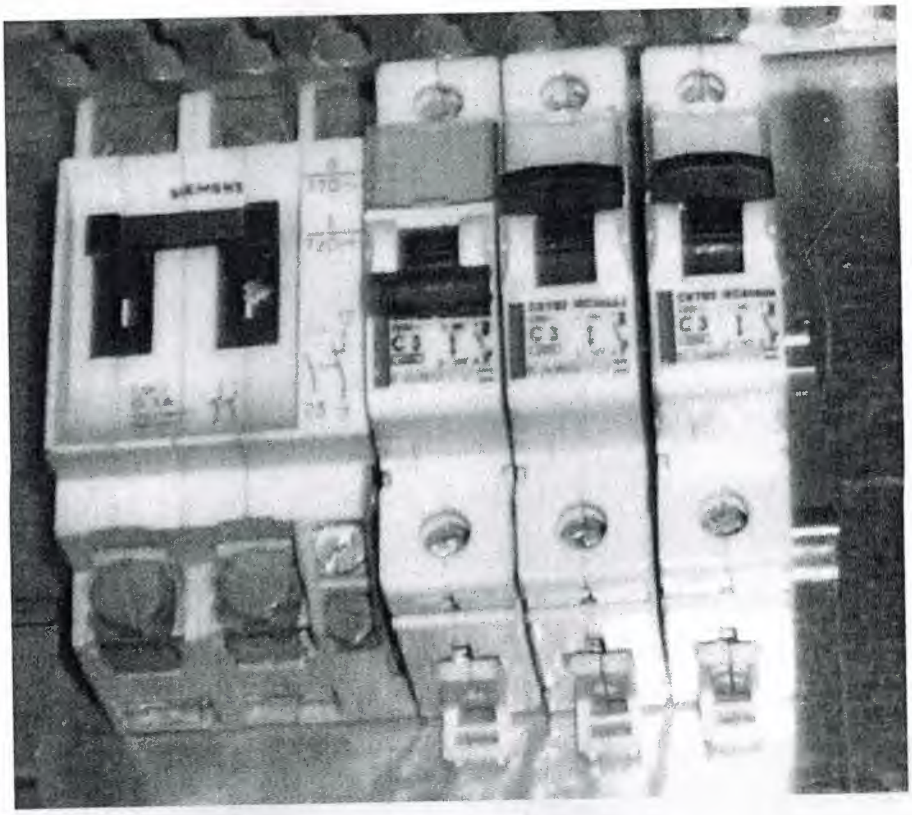

Figure 2.11: Circuit breakers used during designing

During the project they are used to protect transformer and also whole circuit.

2.1.5 Motor

It is a 12V motor supplied by our assistant lecturer Samet Biricik. When it is fed by 12V, it was very slow and even did not make the car move. Then we tried it with 24V and it worked and obtained little faster speed but at least it made the car moves.

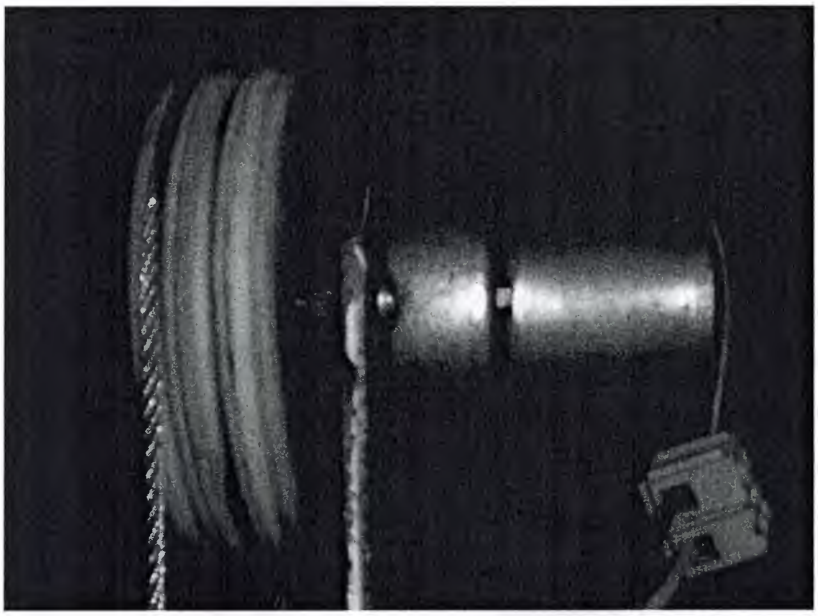

Figure 2.12: Side view of the motor when connected

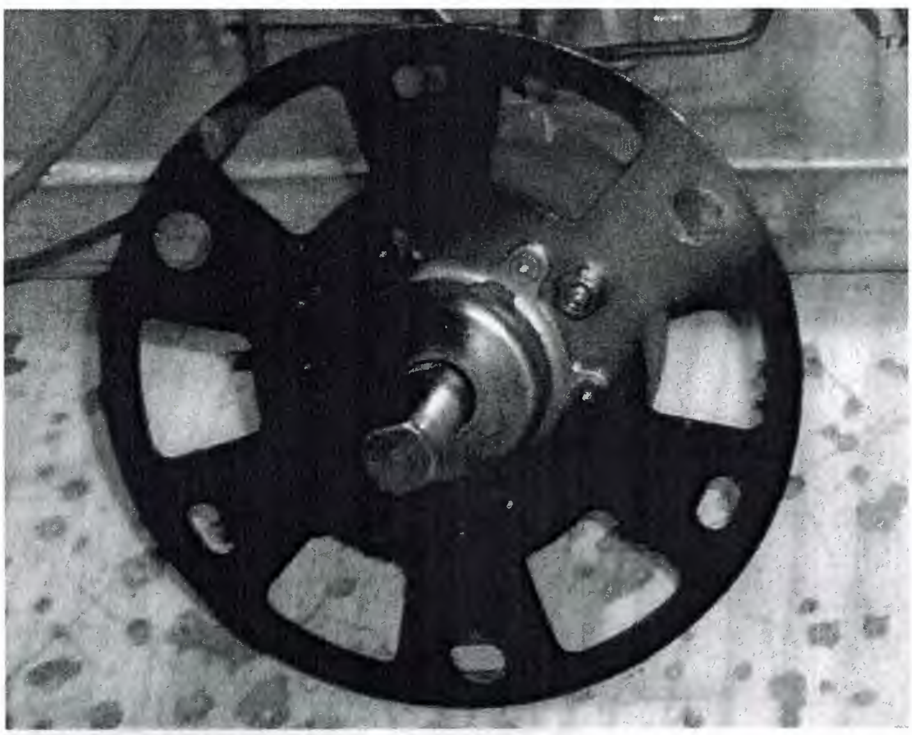

Figure 2.13: Front view of the motor

As it can be seen on figure 2.12, a pulley is added to the motor for ropes to move easily. It is bigger than normal size for this size motor, it was done so the motor speed and efficiency are increased.

2.1.6 Magnetic Tube

With the help of magnets, they decide if the car arrives to ordered floor and tell which floor the car is currently waiting.

In the project three paired, total six magnetic tubes were used. They are stable. On the car body, there are four magnets. Two of them are facing green side and other two facing red side. They order as green, red, red, green. Reds are simulating the magnetic tubes and decide that lift car is on the floor and stop the car also they decide which floor the lift is currently waiting.

For example the car is on 1st floor and called from ground floor, the red magnet already simulated the contact so it is open so the current could not move toward the right side (see appendix ….) so then it goes to the left side and make the car goes down.

Figure 2.14: Magnetic tube

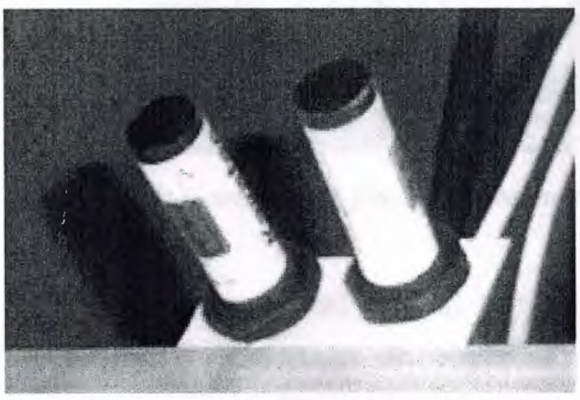

Figure 2.15: Magnetic tubes that used for lift

2.2 Procedure

All the building procedure was happened in our sponsor work place. All materials were obtained from them.

As a first step, we decided which design we will use. We picked up the best and most convenient for us *(see appendix A).* Then we chose the parts we needed. We sometimes faced problems when choosing parts because most of them are for normal size lifts.

After choosing the parts we started to place them on a metal board. We placed the channel and then placed the parts on it. Component placing can be seen on figure 2.16.

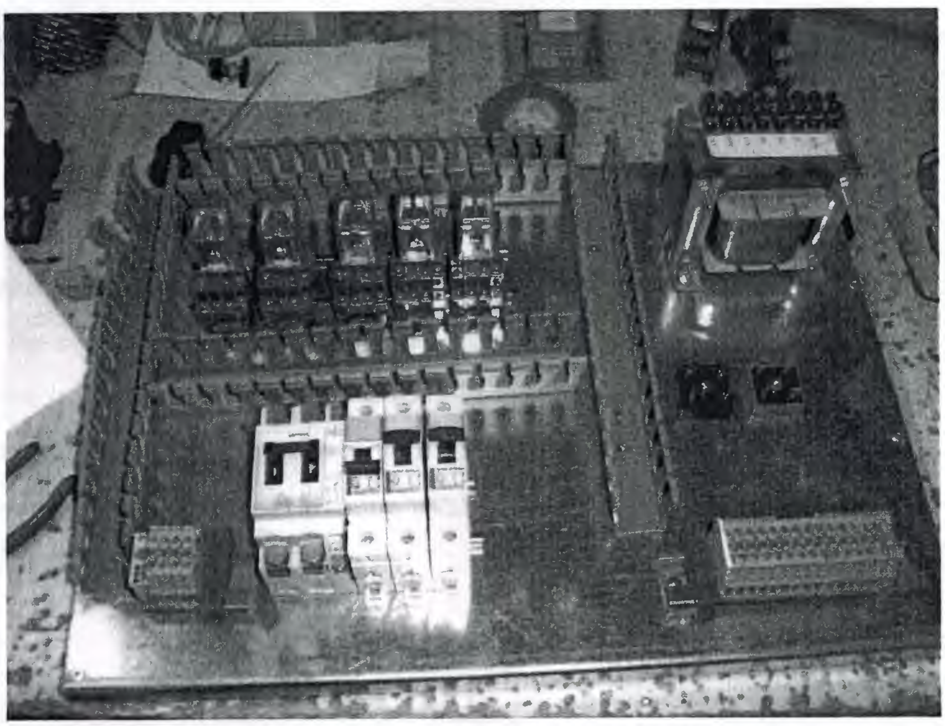

Figure 2.16: Components placed on the metal board.

After placing and making sure that we did everything correct, we started doing connections. By reading the connections tables, we did the connections. It was the most difficult part because any wrong connection causes big troubles. The following figure is showing some connections.

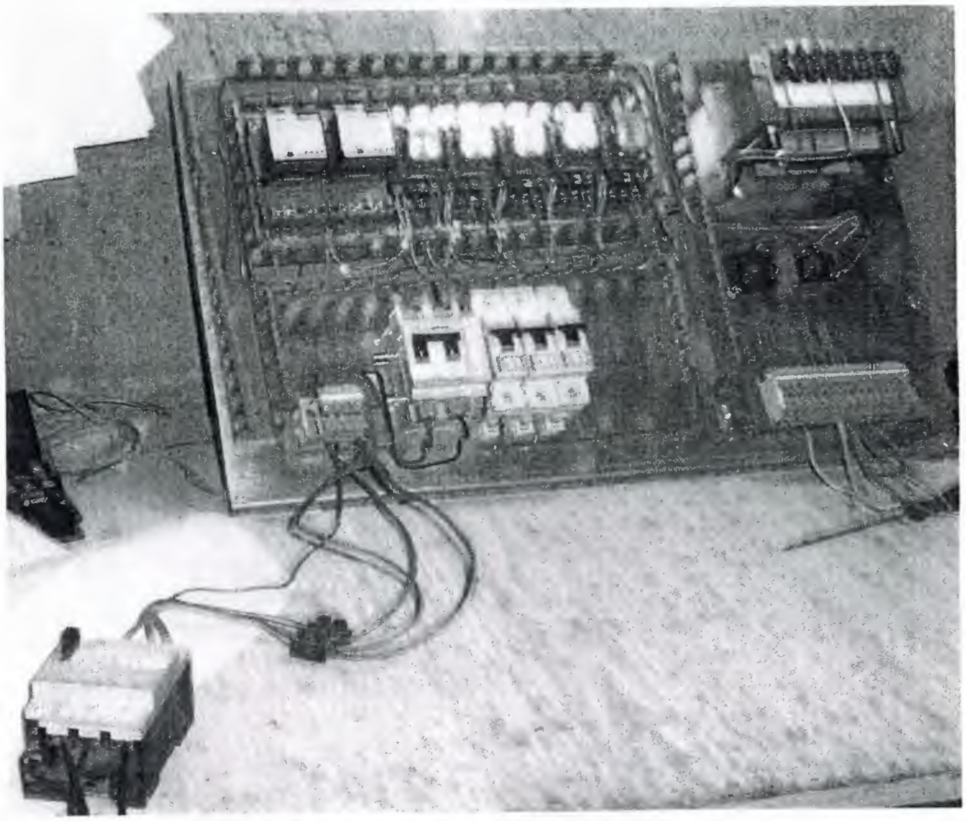

Figure 2.17: All connections of the control panel.

When we finished the connections, we asked the technical man to check our connections. His suggestion was instead of him checking, we checked our circuit by connecting power supply as seen on figure 2.17. After that we connected our motor to the circuit to see if it is really rotation the motor. When we connected the motor, we fed it with 12 V. It was fine but in further steps when we connected the car, it was too weak to rotate it. Therefore we changed to 24 V and it got better.

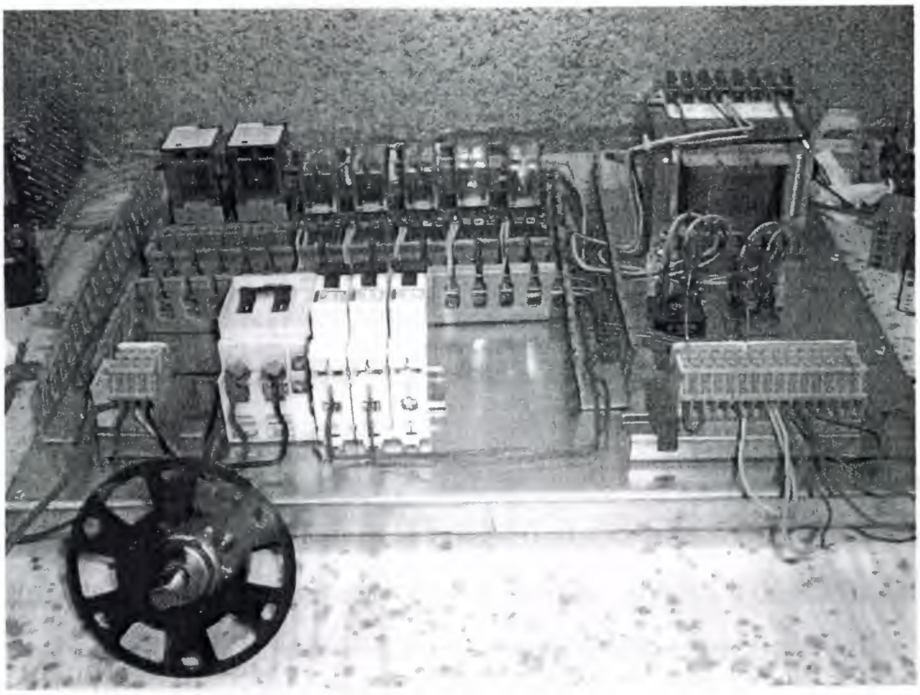

Figure 2.18: When motor connected.

After all these procedure, it was the time for building frame and car of the lift. Our sponsor's workers helped us on bending metals and welding them. When the frame and car were ready, we did the connections and connected call buttons. Then we pressed our buttons to run the car but our motor was too weak to move the car. To solve this problem, we connected 24V instead of 12V. It made the car moves and we complete our project successfully. *(see appendix B)*

CONCLUSION

As the main aim of this project is to learn more about how to combine parts and make them work synchronously, we had deal with lots of components and chose the correct ones. When thinking from external view, combining parts and building a lift sounds at first instant easy but not actually.

When designing the main control panel, some electronic components were picked up and combined in suitable order. It is important to combine suitable parts, their voltage and other important properties should be decided very carefully. This decision mostly depends on the experiences as during project, several parts had burnt because of our carelessness.

When designing the car of the lift, the size of car and motor capacity should be carefully take consider. In our lift, motor is a bit weak for the car but still working.

Lastly when designing the rail and frame, it is purely mechanical work and as mentioned before depend on experiences. There were not serious problems when doing mechanical parts.

In future, for making design smaller, the smaller parts might be requested from manufacturing companies then there will be lesser problems and smaller lift.

REFERENCES:

[1] Barlas E., “Verimlilik”, Asansor Dunyasi, January 2008, pp 81

[2] Akdemir L., “Guvenlik Tertibatlari”, Asansor Dunyasi, volume 75 Ocak 2007

[3] Ozkirim M., Imrak E., Fetvaci C., “Asansor Tesislerinde Planli Ve Erken Uyarici Bakim” volume 79 eylul 2007

[4]Boylestad R., “Electronin Devices and Circuit Theory”, Pearsons

[5] http://www.controlresourcesinc.com/pdfs/findercrossref.pdf

[6] www.wikipedia.org/elevator

APPENDIX A:

<u>Connections diagram of the control panel:</u>