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Design of a transistor-based H-bridge DC motor drive circuit applied to an Elevator for car doors transportation.

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Design of a transistor-based H-bridge DC motor drive circuit applied to an Elevator for car doors transportation.

Abstract **- This paper presents the design of an H-bridge DC motor drive circuit to be applied to an elevator used for transporting car doors in a motor plant industry. The circuit will drive two DC motors simultaneously clockwise and anti-clockwise. The direction of these motors will be controlled by two separate push button switches. The H-bridge circuit will be designed using 4 transistors each connected to its own diode for protection against back emf voltage produced by the motors. This carrier elevator will be pulled or pushed (up and down) by the motors in the bridge circuit and when the elevator reaches a certain height above ground level it will transport the car doors horizontally towards the vehicle which awaits installation.**

Keywords *– H-bridge drive, pneumatic machine, motor plant benefit, proteus software.*

I INTRODUCTION

Nowadays H-bridge circuits are the most preferable circuits used for driving DC motors in two directions. These circuits can be designed in such a way that they can be completely independent units, reusable from project to project. H-bridge is a very effective method for driving motors (ordinary or gearhead). It is defined as an electronic circuit that can allow a voltage to be applied across a load in any direction. H-bridge circuits are frequently used in robotics and many other applications to enable DC motors to run forward and backward. Hence in this project an H-bridge was designed and used to control an elevator for transporting car doors in a car assembly or manufacturing plant.

One of the main problems experienced in manufacturing plants is the maintenance of machines used for production such as the pneumatic machine for doors transportation. Hence this paper describes the design of the car doors carrier elevator which will be used to transport doors to the car waiting for installation thereby replacing the use of the pneumatic machine. However, the elevator will be driven by motors with current emanating from the H-bridge circuit and most DC gear head motors need a large current of 250 mA and above to turn. The problem in driving a DC motor using an H-bridge based on an Integrated Circuit (IC) lies in the large current drawn by the motor. This large current would burn the integrated circuit. There is a need of a circuitry that can act as a bridge between ICs and the motor itself [1].

The most efficient H-bridge circuit can be designed using intrinsic bipolar transistors in arrangement. These arrangements will have the smallest voltage-drop across each of the transistors. As a result, maximum voltage will be delivered to the DC motor [2] and the motor will produce the maximum torque (power). The motor will then draw the maximum current when fully loaded [3] that can be handled by the selected transistors.

The car doors carrier elevator is designed to be energy efficient. This is achieved by using two motors for the push and pull mechanism and combining this with a counterweight for balancing the lifting weight. The motors move at a low speed to avoid doors falling and getting damaged close to the floor level of the plant. The motors will then move the doors closer to the car and replace the use of the pneumatic machine.

Previous researchers built and H-bridge to drive a DC motor forward and back wards by using 4 switches (sw1-sw4) with the load (motor) at the centre to form an H shape. In this arrangement the top two switches are called high side right and high side left. The bottom switches are called low side left and low side right. The switches are turned on in pairs diagonally, example high side left and low side right. The problem with this arrangement is that a short circuit is created between the battery poles. This melts the switches and is called switch-mode power supply (SMPS) [4].

In the previous designs of the car doors carrier elevator, electric wire rope hoist were used. However, these could carry only a small capacity. Due to advances in technology control systems were implemented with elevators to improve safety and lifting loads. Further improvements led to the use of counterweights which reduced the load the motor had to lift. This counterweight is equal to the elevator weight plus 40% of the maximum load [5]. However pneumatic machines where still required to bring the car doors closer to the vehicle waiting for assembly. The purpose of this project is for the elevator design [6] to

bring the car doors closer to the vehicle waiting for installation and replace the use of the pneumatic machines.

The objective of this project is to design an H-bridge circuit that drives two DC motors forward and backwards in order to operate an elevator that is used in the motor plant company to transport car doors during production. The circuit will be simulated in proteus software [7] before it is built on the board. The elevator would be operated through the H-bridge [8-15] circuit. The two DC motors will push and pull the elevator vertically (up and down). When the elevator reaches a certain height above ground level aligned to the car it will stop and move horizontally towards the car carrying the car doors. This functionality replaces the use of the pneumatic machine.

II. METHODOLOGY

The transistor-based H-bridge DC motors drive was designed using 4 bipolar transistors and 4 diodes. The diodes are connected to each transistor to protect them against overvoltage or undervoltage from the DC motors. Resistors will be connected to limit the base current of the transistor. Two push button switches were used for the purpose of controlling the forward and backward movement of the two DC motors simultaneously. A PC board was used for the prototype design. The circuit will be supplied by 9V. The design is simulated using proteus software.

Fig. 1 shows the simulation of the H-bridge DC motors drive circuit in proteus software. In this case the left push button switch is kept open and the right push button switch is closed these drives the motors anticlockwise. In the clockwise drive the left push button switch is closed, and the right push button switch is opened. These relate to forward and backwards movement respectively.

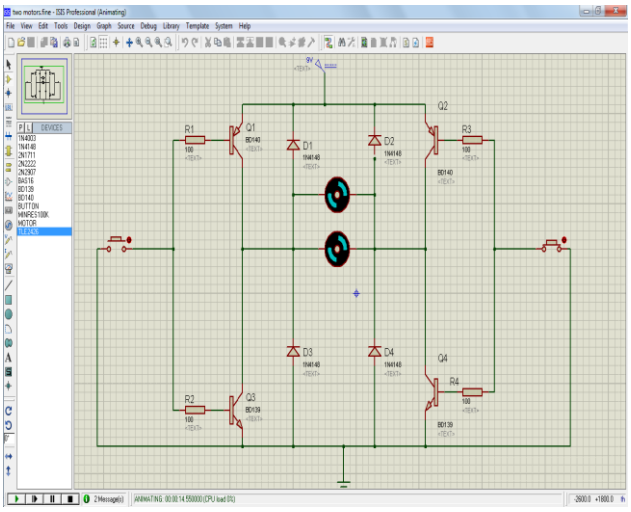

Fig. 1. Transistor based H bridge circuit spinning two motors Anti-clockwise in proteus simulation.

Figure 2 shows the block diagram of the overall design indicating how the bridge circuit and the elevator will be linked together.

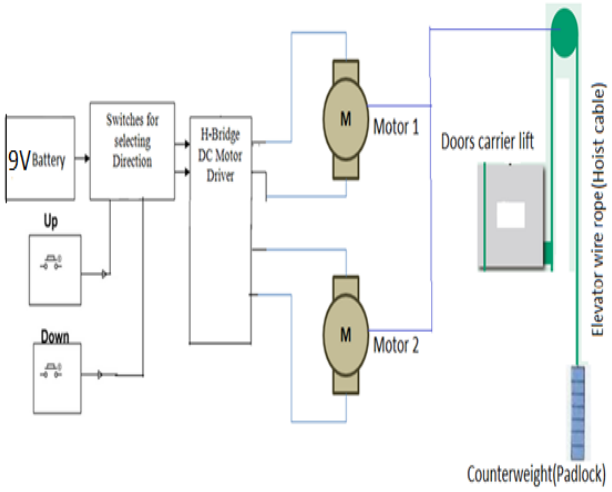

Fig. 2 Block diagram of the H-bridge DC motors drive controlling Elevator system.

III. RESULTS

Fig. 3 shows the complete prototype design. The H-bridge circuit is now connected to the elevator design. The motors are placed on top of the elevator assembly to pull and push the elevator vertically. A 9 V power supply is connected to the H-bridge circuit to supply power. Car doors are also shown in Fig.3 below being carried by the elevator.

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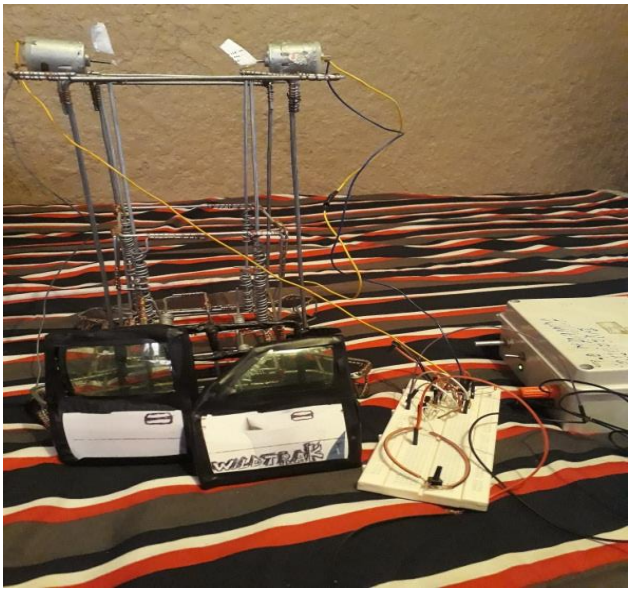

Fig. 3. A complete prototype design of the H bridge circuit, DC motors and the car doors carrier elevator.

IV CONCLUSION

In conclusion an H-bridge DC motor drive circuit was designed using discrete bipolar junction transistors. This H-bridge circuit was used to operate an elevator to transport car doors for installation on a vehicle and therefore replace the pneumatic system. Proteus software was used to simulate the prototype. The DC motors move forward and backward controlled by push button switches while the elevator moves vertically and horizontally transporting the car doors.

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