DESIGN AND CONSTRUCTION OF AN ELECTRIC HAND BLOWER.

BY
ANGBASHUM, UTUANGBA H.
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DECLARATION

I, Angbashum Utuangba declare that this work was done by me and has never been presented elsewhere for the award of a degree. I hereby relinquish the copyright to the Federal University of Technology, Minna.

Angbashum Utuangba
(Name of student)

(Signature and Date)

CERTIFICATION

This is to certify that this project titled "Design and construction of an electric hand blower" was carried out by Angbashum Utuangba with the registration number 2005/22008EE, under the supervision of Engr. Dr. M. N. Nwohu and submitted to the department of Electrical and Computer Engineering, Federal University of Technology, Minna.

Engr. Dr. M. N. Nwohu
(Name of supervisor)

6/12/2010
(Signature and Date)

Engr. A. G. Raji
(Head of Department)

(Jan. 27, 2011)
(Signature and Date)

Engr. Dr. G. I. Igbalo
External Examiner

25/1/11
(Signature and Date)

DEDICATION

This project is dedicated to Almighty God, my parents and my siblings.

ACKNOWLEDGEMENT

I would like to express sincere gratitude to God Almighty for the gift of life as well as wisdom, knowledge and understanding for the execution of this project.

I specially want to acknowledge the efforts my parents, Mr. and Mrs. J. I. Angbashum, my siblings, Amenganga, Henrietta and Henry in supporting and encouraging me, throughout my studies in University.

Profound gratitude goes to my supervisor Engr. Dr. M. N. Nwohu and Mr. K. Bagudu for their patience and understanding in guiding me through the project. I want to also use this medium to appreciate the effort of my lecturers in making me to be what I am today.

Finally, I want to appreciate the company of my friends who are helpers sent to me in desperate times and they are, Martin Dillum, Edmund Effa, Aisha Ndahi, Aziz Salka, Shedrack Muazu, Okuyelu Morayo, Charles Ekanem, Nuan Shuibu, Abubakar Halidu and Abdulmajeed Muazu.

ABSTRACT

This project is about an electric hand blower. It eradicates a lot of stress involved in cleaning of electric circuits and helps in the maintenance of these circuits. The construction involved the use of an electric motor, specifically, the synchronous motor. It also comprises a fan which manipulates the direction of air current inside chamber of the machine. The type of fan that was used in accomplishing this project is the forward curved type, because of its unique property. The introduction of a switch was necessary since there will be need to control the passage of electric current in the circuit. The need of a protecting device arises since we are dealing with an electric circuit, hence the use of an electric fuse to protect the circuit.

Considering the nature of the machine, the casing of this machine was designed to accommodate these components, and to enclose the circuit vulnerable to dust. In an attempt to achieve this, the use of metal sheet was considered in constructing this project, and the introduction of plastic to insulate some part of the machine.

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CHAPTER ONE

INTRODUCTION

An Electric hand blower is a hand held machine that is used for blowing off dust from complicated appliances, especially the ones with electric circuits. The machine has been in existence, but quite uncommon; this is why the use of rags and brushes are still in practice, despite the knowledge of the dangers involved in using them. This project gives an insight to the production of this machine, an electric hand blower.

In the design and construction of an Electric Hand Blower, electric motor is the main component used for the realisation of the project.

Electric motor is a device that is used to convert electrical energy into mechanical energy, by electromagnetic means. Some applications of the electric motor include

- Automation industries.
- Elevators- devices for vertical transportation of passengers or freight to different floors or levels, as in a building or a mine.
- Pulley-Modern pulley systems are often combined with motors to create hoists for lifting heavy loads. By using a motor, the user only has to push a button to lift or lower the load.

More on the electrical motor will be discussed in chapter three

1.1 AIMS

The aim of this project is to construct an electric hand blower.

1.2 MOTIVATION

Removal of dust on electric circuit is very important in order to enhance the effective operation of the components on the circuit. Therefore blowing away the dust is not only the easiest way of achieving this, but also the safest and the fastest. In electrical engineering, the use of brushes and rags for the accomplishment of this task is not always advisable, hence the motivation to design and construct an electric hand blower.

1.3 PROJECT OUTLINE

This project on the design and construction of an electric hand blower extensively discussed at various stages is outlined, thus, chapter one covers the general introduction of the machine that is under consideration and what it does, its advantages and how important they are in making life better as well as what prompt the choosing of the project work. Chapter two deals more on each unit or component that makes up the entire machine, i.e. the choice of the components used and why they were chosen over others, the introduction of these components and their working principles were also highlighted in this chapter. Chapter three deals with the design, implementation and the construction process involved in the project and the major calculations that were involved in implementing the project. Chapter four discusses the report on the testing of the project, and comparing the result of the test, whether it meets the desired result. Finally, the conclusion is stated in chapter five. It covers the summary of the work presented, the result of the work as compared with what was expected and the problems encountered in the project work.

CHAPTER TWO

LITERATURE REVIEW

The electric hand blower is a machine that forces air at high speed and pressure to blow off dust and unwanted light materials from appliances. The concept of design of this machine is what is considered in this chapter as well as the components that are used in achieving this work. These components or units include the fan, a protecting device (fuse), the switch and the motor which happens to be the key part of the machine. All the above components, from their distinct characteristics to their various modes of operation which are supported with diagrams and sketches to give clearer understanding are discussed in this chapter.

2.1 MOTOR

A machine that converts mechanical energy into electrical energy is called a generator, alternator, or dynamo, and a machine that converts electrical energy into mechanical energy is called a motor.

The electric motor is responsible for the entire movement of the machine, and is of great importance to the design. Motor is a device that creates motion. It can be classified as follows:

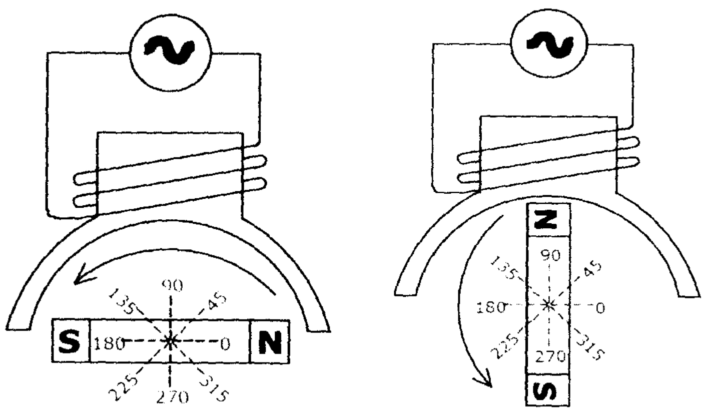
- Synchronous motor, an alternating current motor distinguished by a rotor spinning with coils passing magnets at the same rate as the alternating current and resulting magnetic field which drives it.
- Induction motor, also called a squirrel-cage motor, a type of asynchronous alternating current motor where power is supplied to the rotating device by means of electromagnetic induction.

- DC motor, an electric motor that runs on direct current electricity.
- AC motor, an electric motor that is driven by alternating current.
- Brushed DC electric motor, an internally commutated electric motor designed to run from a direct current power source.
- Brushless DC motor, a synchronous electric motor which is powered by direct current electricity and has an electronically controlled commutation system, instead of a mechanical commutation system based on brushes.
- Electrostatic motor, a type of electric motor based on the attraction and repulsion of electric charge.
- Servo motor, an electric motor that operates a servo, commonly used in robotics [1].

A motor can carry one or two of the above listed property.

2.1.1 Mode of operation of an electric motor

The basic concept that is associated with the rotation of an electric motor is as shown below.



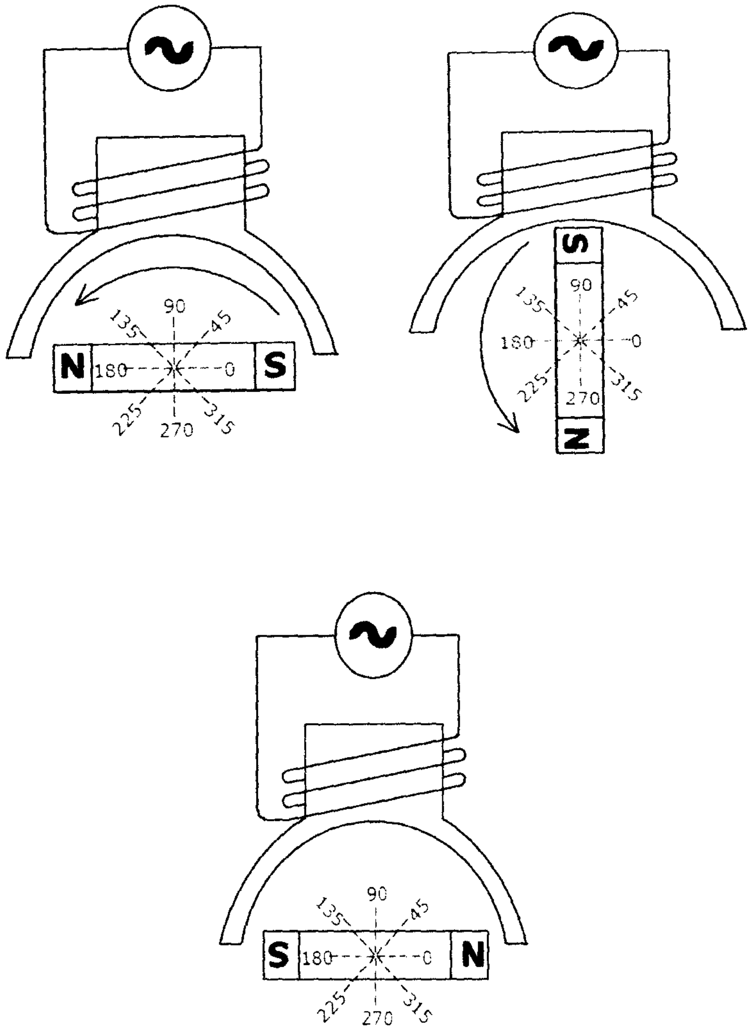


Fig. 2.1: Principle of rotation of an electric motor.

From the first law of thermodynamics which states that 'Energy can neither be created, nor destroyed, but can be transformed from one form to another'. An Electric motor is a machine which converts electric energy into mechanical energy; its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's left hand rule as shown in Fig. 2.1 above. Electric motors are in categories and types, the one that is considered and used in this project is the synchronous motor.

A synchronous electric motor is an AC motor distinguished by a rotor spinning with coils passing magnets at the same rate as the alternating current and resulting magnetic field which drives it. Another way of saying this is that it has zero slip under usual operating conditions, contrast to this, is an induction motor, which must slip in order to produce torque. They operate synchronously with line frequency. In the case of squirrel-cage induction motors, speed is determined by the number of pairs of poles and the line frequency. Synchronous motors are available in sub-fractional self-excited sizes to high-horsepower direct-current excited industrial sizes. In the fractional horsepower range, most synchronous motors are used where precise constant speed is required. In high-horsepower industrial sizes, the synchronous motor provides two important functions. Firstly, it is a highly efficient means of converting ac energy to work. Secondly, it can operate at leading or unity power factor and thereby provide power-factor correction. There are two major types of synchronous motors: non-excited and direct-current excited.

Slip rings and brushes are used to conduct current to the rotor. The rotor poles connect to each other and move at the same speed - hence the name synchronous motor. Synchronous motors fall under the category of synchronous machines which also includes the alternator (synchronous generator) [2].

The speed of a synchronous motor is determined by the following formula:

$$v = \frac{120 \times f}{n}$$

where, v is the speed of the rotor (in rpm), f is the frequency of the AC supply (in Hz) and n is the number of magnetic poles.

2.1.2 Operation of a synchronous motor

The operation of a synchronous motor is simple. The armature winding, when excited by a poly-phase (usually 1 to 3-phase) winding, creates a rotating magnetic field inside the motor. The field winding, which acts as a permanent magnet, simply locks in with the rotating magnetic field and rotates along with it. During operation, as the field locks in with the rotating magnetic field, the motor is said to be in synchronization.

Once the motor is in operation, the speed of the motor is dependent only on the supply frequency. When the load of the motor is increased beyond the break down load, the motor falls out of synchronization i.e., the applied load is large enough to pull out the field winding from following the rotating magnetic field. The motor immediately stalls after it falls out of synchronization.

Synchronous motors are not self-starting motors. This property is due to the inertia of the rotor. When the power supply is switched on, the armature winding and field windings are excited. Instantaneously, the armature winding creates a rotating magnetic field, which revolves at the designated motor speed. The rotor, due to inertia, will not follow the revolving magnetic field. In practice, the rotor should be rotated by some other means near to the motor's synchronous speed to overcome the inertia. Once the rotor gets closer to the synchronous speed, the field winding is excited, and the motor pulls into synchronization. The following techniques are employed to start a synchronous motor:

- A separate motor (called pony motor) is used to drive the rotor before it locks in into synchronization.
- The field winding is shunted or induction motor like arrangements are made so that the synchronous motor starts as an induction motor and locks in to synchronization once it reaches speeds near its synchronous speed [2].

Synchronous motors have the following advantages over non-synchronous motors:

- Speed is independent of the load, provided an adequate field current is applied.
- Accurate control in speed and position using open loop controls, e.g. stepper motors.
- Their construction allows for increased electrical efficiency when a low speed is required.

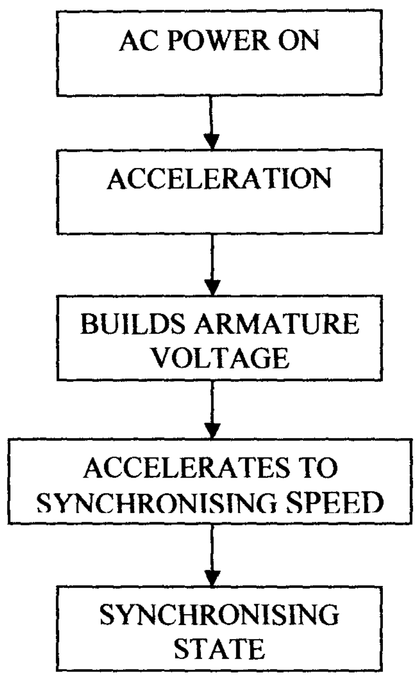


Fig. 2.2: Excitation process of a synchronous motor

2.2 THE FAN

A fan is a powered device used to create and control the flow of gas, usually air. A fan consists of a rotating arrangement of vanes or blades which act on the air. Usually it is contained within some form of housing or case. Typical applications include climate control, vehicle and machinery cooling systems, personal comfort (e.g., an electric table fan), ventilation, fume extraction, winnowing (e.g., separating chaff of cereal grains), removing dust (e.g. in a hand blower), drying (usually in combination with heat) and to provide draft for a fire.

Mechanical revolving blade fans are made in a wide range of designs, there are three main types of fans used for moving air, axial, centrifugal (also called radial) and cross flow (also called tangential) [3].

2.2.1 The centrifugal fan

Often called a "squirrel cage" (as it looks like a hamster wheel), the centrifugal fan has a moving component (called an impeller) that consists of a central shaft about which a set of blades, or ribs, are positioned as shown in Fig. 2.3. Centrifugal fans blow air at right angles to the intake of the fan, and spin the air outwards to the outlet (by deflection and centrifugal force). The impeller rotates, causing air to enter the fan near the shaft and move perpendicularly from the shaft to the opening in the scroll-shaped fan casing. A centrifugal fan produces more pressure for a given air volume, and is used where this is desirable such as in leaf blowers, blow dryers, air mattress inflators, inflatable structures, climate control, and various industrial purposes. They are typically noisier than comparable axial fans.

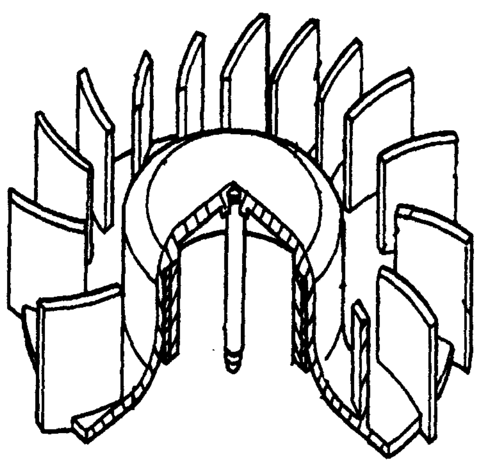


Fig. 2.3: Sectioned Centrifugal Fan.

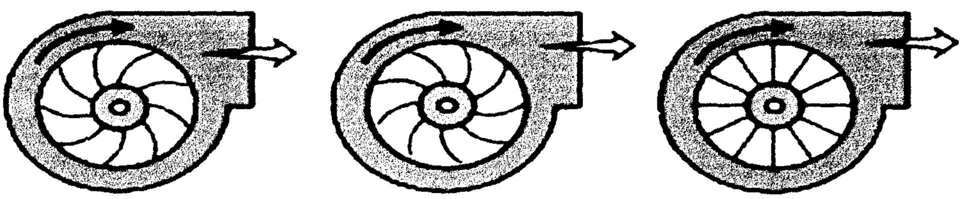
The major components of a typical centrifugal fan include the fan wheel, fan housing, drive mechanism, and inlet-outlet dampers.

Drive mechanism used

In Direct drive, the fan wheel is linked directly to the shaft of the electric motor. This means that the fan wheel speed is identical to the motor's rotational speed. With this type of fan drive mechanism, the fan speed cannot be varied unless the motor speed is adjustable [4].

Fan ribs

Centrifugal fan blades, the fan wheel consists of a hub on which a number of fan blades are attached. The fan blades on the hub can be arranged in three different ways: forward-curved, backward-curved or radial [5].



(a) Forward curved (b) Backward curved (c) Radial

Fig. 2.4

- **Forward-curved blades**

Forward-curved blades, use blades that curve in the direction of the fan wheel's rotation. These are especially sensitive to particulates. Forward-curved blades are for high flow, low pressure applications.

- **Backward-curved blades**

Backward-curved blades, use blades that curve against the direction of the fan wheel's rotation. The backward curvature mimics that of an airfoil cross section and provides good operating efficiency with relatively economical construction techniques. These types of fan wheels are used in fans designed to handle gas streams with low to moderate particulate loadings. They can be easily fitted with wear protection but certain blade curvatures can be prone to solids build-up. Backward curved fans can have a high range of specific speeds but are most often used for medium specific speed applications-high pressure, medium flow applications. Backward-curved fans are much more energy efficient than radial blade fans and so, for high power applications may be a suitable alternative to the lower cost radial bladed fan [4].

- **Straight radial blades**

Radial fan blades, as in Fig. 2.4(c), extend straight out from the hub. A radial blade fan wheel is often used on particulate-laden gas streams because it is the least sensitive to solids build-up on the blades, but it is often characterized by greater noise output. High speeds, low volumes, and high pressures are common with radial fans, and are often used in vacuum cleaners, pneumatic material conveying systems, and similar processes.

2.2.1.1 Centrifugal fan ratings

Ratings found in centrifugal fan performance tables and curves are based on standard air. Fan manufacturers define standard air as clean, dry air with a density of 0.075 pounds mass per cubic foot (1.2 kg/m³), with the barometric pressure at sea level of 29.92 inches of mercury (101.325 kPa) and a temperature of 70°F (21°C). Selecting a centrifugal fan to operate at conditions other than standard air requires adjustment to both static pressure and power. The volume of air will not be affected in a given system because a fan will move the same amount of air regardless of the air density [4].

If a centrifugal fan is to operate at a non-standard density, then corrections must be made to static pressure and power. At higher than standard elevation (sea level) and higher than standard temperature, air density is lower than standard density. Centrifugal fans that are specified for continuous operation at higher temperatures need to be selected taking into account air density corrections. Again, a centrifugal fan is a constant volume device that will move the same amount of air at two different temperatures.

If, for example, a centrifugal fan moves 1,000 ft^3/min (0.5 m^3/s) at 70 °F (21 °C) it will also move 1,000 ft^3/min (0.5 m^3/s) at 200 °F (93 °C). Centrifugal fan air volume delivered by the centrifugal fan is not affected by density. However, since the 200 °F (93 °C) air weighs much less than the 70 °F (21 °C) air, the centrifugal fan will create less static pressure and will require less power. Selecting a centrifugal fan to operate at conditions other than standard air requires adjustment to both static pressure and power. When a centrifugal fan is specified for a given CFM and static pressure at conditions other than standard, an air density correction factor must be applied to select the proper size fan to meet the new condition. Since 200 °F (93 °C) air weighs only 80% of 70 °F (21 °C) air, the centrifugal fan will create less pressure. To get the actual pressure required at 200 °F (93 °C), the designer would have to multiply the pressure at standard conditions by an air density correction factor of 1.25 (i.e., 1.0/0.8) to get the system to operate correctly. To get the actual power at 200 °F (93 °C), the designer would have to divide the power at standard conditions by the air density correction factor.

2.2.2 Axial fans

An axial box fan is mostly used for cooling electrical equipment. The axial-flow fans have blades that force air to move parallel to the shaft about which the blades rotate. Axial fans blow air along the axis of the fan, linearly, hence their name. This type of fan is used in a wide variety of applications, ranging from small cooling fans for electronics to the giant fans used in wind tunnels. Example of this type of fan is the table fan, A Ceiling fan is also an example of the axial fan, a fan suspended from the ceiling of a room is a ceiling fan [3].

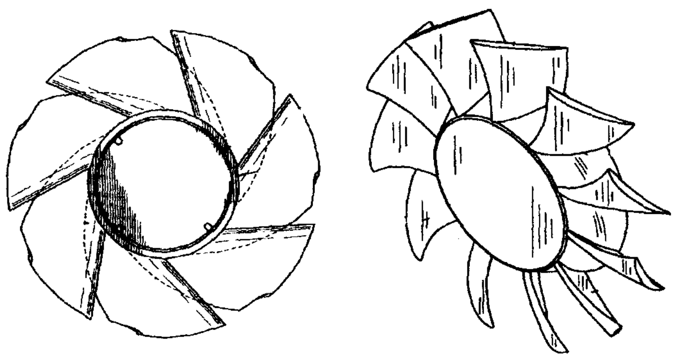


Fig. 2.5: Axial Fan

Fig. 2.5 shows a sample of the axial fan-Computer cooling fan, Variable Pitch Fan: A variable-pitch fan is used where precise control of static pressure within supply ducts is required. The blades are arranged to rotate upon a control-pitch hub. The fan wheel will spin at a constant speed. As the hub moves toward the rotor, the blades increase their angle of attack and an increase in flow results [3].

2.2.3 Crossflow fan

The crossflow or tangential fan, sometimes known as a tubular fan was patented in 1893 by Mortier, and is used extensively in the HVAC industry. The fan is usually long in relation to the diameter, so the flow approximately remains two-dimensional away from the ends. The Crossflow fan uses an impeller with forward curved blades, placed in a housing consisting of a rear wall and vortex wall. Unlike radial machines, the main flow moves transversely across the impeller, passing the blades twice.

The flow within a crossflow fan may be broken up into three distinct regions: a vortex region near the fan discharge, called an eccentric vortex, the through-flow region, and a paddling region directly opposite. Both the vortex and paddling regions are dissipative, and as a result, only a portion of the impeller imparts usable work on the flow. The crossflow fan, or transverse fan, is thus a two-stage partial admission machine. The popularity of the crossflow fan in the HVAC industry comes from its compactness, shape, quiet operation, and ability to provide high pressure coefficient. Effectively a rectangular fan in terms of inlet and outlet geometry, the diameter readily scales to fit the available space, and the length is adjustable to meet flow rate requirements for the particular application.

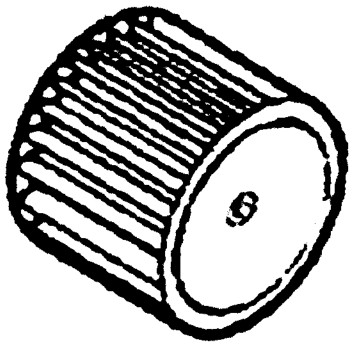


Fig. 2.6: Crossflow Fan

Ancient work focused on developing the crossflow fan for both high and low-flow-rate conditions, and resulted in numerous patents. Key contributions were made by Coester, Ilberg and Sadeh, Porter and Markland, and Eck. One interesting phenomenon, particularly, to the crossflow fan is that, as the blades rotate, the local air incidence angle changes. The result is that in certain positions the blades act as compressors (pressure increase), while at other azimuthal locations the blades act as turbines (pressure decrease) [3].

2.3 FUSE

In electronics and electrical engineering, a fuse (from the Latin "fusus" meaning to melt) is a type of sacrificial over-current protection device. Its essential component is a metal wire or strip that melts when too much current flows, which interrupts the circuit in which it is connected. Short circuit, overload or device failure is often the reason for excessive current.

A fuse interrupts excessive current (blows) so that further damage by overheating or fire is prevented. Wiring regulations often define a maximum fuse current rating for particular circuits. Over-current protection devices are essential in electrical systems to limit threats to human life and property damage. Fuses are selected to allow passage of normal current and of excessive current only for short periods.

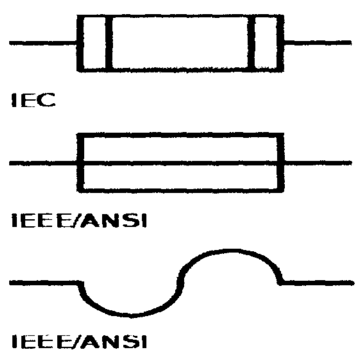


Fig. 2.7: Electronic symbols for a fuse.

A fuse was patented by Thomas Edison in 1890 as part of his successful electric distribution system [6].

2.3.1 Breaking capacity

The breaking capacity is the maximum current that can safely be interrupted by the fuse. Generally, this should be higher than the prospective short circuit current. Miniature fuses may have an interrupting rating only 10 times their rated current. Some fuses are designated High Rupture Capacity (HRC) and are usually filled with sand or a similar material. Fuses for small, low-voltage, usually residential, wiring systems are commonly rated to interrupt 10,000 amperes. Fuses for larger power systems must have higher interrupting ratings, with some low-voltage current-limiting high interrupting fuses rated for 300,000 amperes. Fuses for high-voltage equipment, up to 115,000 volts, are rated by the total apparent power (megavolt-amperes, MVA) of the fault level on the circuit.

2.3.2 Rated voltage

Voltage rating of the fuse must be greater than or equal to what would become the open circuit voltage. For example, a glass tube fuse rated at 32 volts would not reliably interrupt current from a voltage source of 120 or 230 V. If a 32 V fuse attempts to interrupt the 120 or 230 V source, an arc may result. Plasma inside that glass tube fuse may continue to conduct current until current eventually so diminishes that plasma reverts to an insulating gas. Rated voltage should be larger than the maximum voltage source it would have to disconnect. This requirement applies to every type of fuse. Rated voltage remains same for any one fuse, even when similar fuses are connected in series. Connecting fuses in series does not increase the rated voltage.

Medium-voltage fuses rated for a few thousand volts are never used on low voltage circuits, because of their cost and because they cannot properly clear the circuit when operating at very low voltages.

2.3.3 Voltage drop

A voltage drop across the fuse is usually provided by its manufacturer. Resistance may change when a fuse becomes hot due to energy dissipation while conducting higher currents. This resulting voltage drop should be taken into account, particularly when using a fuse in low-voltage applications. Voltage drop often is not significant in more traditional wire type fuses, but can be significant in other technologies such as resettable fuse.

2.3.4 Temperature derating

Ambient temperature will change a fuse's operational parameters. A fuse rated for 1 A at 25°C may conduct up to 10% or 20% more current at -40°C and may open at 80% of its rated value at 100°C. Operating values will vary with each fuse family and are provided in manufacturer data sheets [6].

2.4 SWITCH

In electronics, a switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts. Each set of contacts can be in one of two states: either 'closed' meaning the contacts are touching and electricity can flow between them, or 'open', meaning the contacts are separated and not conducting [7].

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. Automatically-operated switches can be used to control the motions of machines. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system. For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay. Large switches may be remotely operated by a motor drive mechanism. Some switches are used to isolate electric power from a system, providing a visible point of isolation that can be pad-locked if necessary to prevent accidental operation of a machine during maintenance, or to prevent electric shock. A pair of contacts is said to be "closed" when current can flow from one to the other.

Switches are classified according to the arrangement of their contacts in electronics. Electricians installing building wiring use different nomenclature, such as "one-way", "two-way", "three-way" and "four-way" switches. In a push-button type switch, in which the contacts remain in one state unless actuated, the contacts can either be normally open (abbreviated "n.o." or "no") until closed by operation of the switch, or normally closed ("n.c. or "nc") and opened by the switch action. A switch with both types of contact is called a changeover switch. These may be "make-before-break" which momentarily connect both circuits, or may be "break-before-make" which interrupts one circuit before closing the other. The terms pole and throw are also used to describe switch contact variations. The number of "poles" is the number of separate circuits which are switched by a switch. The number of "throws" is the number of separate positions that the switch can adopt. A single-throw switch has one pair of contacts that can either be closed or open. A double-throw switch has a contact that can be connected to either of two other contacts, a triple-throw has a contact which can be connected to one of three other contacts, etc. Some of the contact terminologies are looked at below.

2.4.1 Power switching

When a switch is designed to switch significant power, the transitional state of the switch as well as the ability to stand continuous operating currents must be considered. When a switch is in the on state its resistance is near zero and very little power is dropped in the contacts; when a switch is in the off state its resistance is extremely high and even less power is dropped in the contacts. However when the switch is flicked the resistance must pass through a state where briefly a quarter (or worse if the load is not purely resistive) of the load's rated power is dropped in the switch. For this reason, power switches intended to interrupt a load current have spring mechanisms to make sure the transition between on and off is as short as possible regardless of the speed at which the user moves the rocker.

Power switches usually come in two types. A momentary on-off switch (such as on a laser pointer) usually takes the form of a button and only closes the circuit when the button is depressed. A regular on-off switch (such as on a flashlight) has a constant on-off feature. Dual-action switches incorporate both of these features. The strength and characteristics of this switch is what I have taken advantage of in the design and construction of this project.

2.5 DUST

Dust is a general name for solid particles with diameters less than 20 thousand (500 micrometres). Particles in the atmosphere arise from various sources such as soil dust lifted up by wind, volcanic eruptions, and pollution. Dust in homes, offices, and other human environments contains small amounts of plant pollen, human and animal hairs, textile fibres, paper fibres, minerals from outdoor soil, and many other materials which may be found in the local environment [8].

Dust is finely divided solids that become airborne through a fracture process from a larger solid object. Common household dust is mainly composed of decayed skin particles, while industrial dust is commonly generated by sawing, grinding, or polishing of wood, metal, plastic, or masonry type materials. Dust particles can be as small as a few microns (micrometers) or as large as hundreds of microns in size. The larger and denser particles tend to settle, while the smaller and lighter ones can remain airborne indefinitely.

Dust generated in factories, wood shops, and workshops are various, and pose a health risk to operators. Dust suppression and dust collection systems are usually employed to capture the majority of the directly generated dust, and various respiratory dust masks are available for human use to minimize the amount of dust inhaled. Industrial dust that escapes the suppression and collection steps will migrate and settle on and within most equipment left unprotected. One of the most vulnerable and common devices found in modern factories and workshops are personal computer electronics, displays, and printers. These devices were not designed for such an environment, and internal dust accumulation is one of the main causes of computer reliability problems or premature failure [9].

2.5.1 DUST EFFECTS ON ELECTRONICS

Personal Computers (PCs) are consumer items designed for office environments where the density of dust in the air is low. Most PCs have no dust filter, or at most, only a low-cost mesh filter designed to capture some of the dust that might be drawn into the PC by the PC's cooling fan. The fan draws in cooling air that passes through the filter and exhaust out various vents in the computer case. Since most offices temperatures are maintained at approximately 75^{o}F, the electronics can be sufficiently cooled even if the internal dust accumulation is moderate. In most office situations, the PC dust accumulation will begin to affect computer operation within 2 years. Internal cleaning should be performed at least annually to prevent problems. PCs are electro-mechanical devices, and they have a variety of susceptibilities to dust. For situations where a PC is used in an environment with higher dust levels, these susceptibilities can surface very quickly [10].

2.6 Principle of operation of an electric hand blower

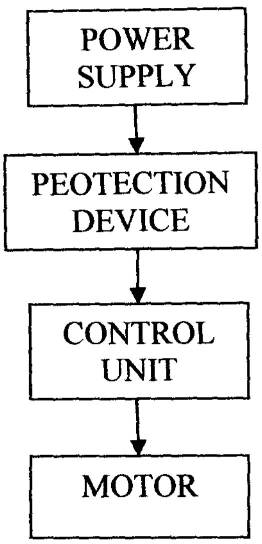


Fig. 2.8: Block diagram of an electric hand blower

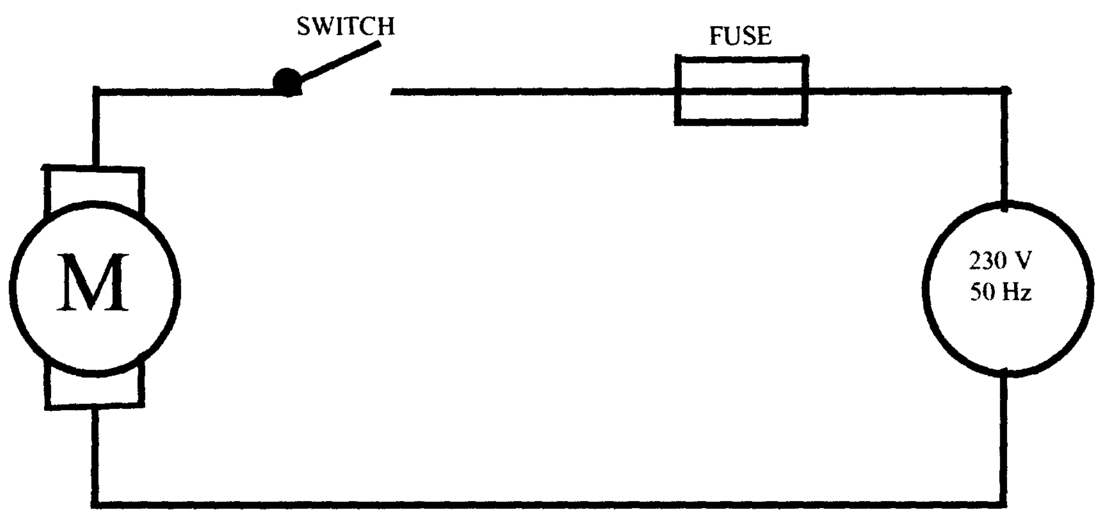


Fig. 2.9: Circuit diagram

Fig. 2.9 shows the circuit diagram of the machine composed of all the electrical components.

CHAPTER THREE

CONSTRUCTION AND IMPLEMENTATION

3.1 DESIGN

Before the construction of this project, it is important to put into consideration the design of the machine so as to enable the maximum use of the components that are to be used in accomplishing the project. The components that help in actualizing the project have been discussed, their characteristics as well as the reasons why they were chosen over others.

3.2 CASING

The material used in for the casing of this project is the sheet metal. Sheet metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bent into a variety of different shapes. Countless everyday objects are constructed of the material. Thicknesses can vary significantly, although extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. There are many different metals that can be made into sheet metal, such as aluminium, brass, copper, steel, tin, nickel and titanium. For decorative uses, important sheet metals include silver, gold, and platinum (platinum sheet metal is also utilized as a catalyst.). The thickness of the sheet metal is called its gauge. The gauge of sheet metal ranges from 30 gauge to about 8 gauge. The higher the gauge, the thinner the metal is [10].

An electric hand blower is a machine that blows air at high pressure. For this to be accomplished there must be inflow and outflow of air. The outflow of air is of major concern to us in this project. The design of this project is based on the operation as shown in Fig. 3.1.

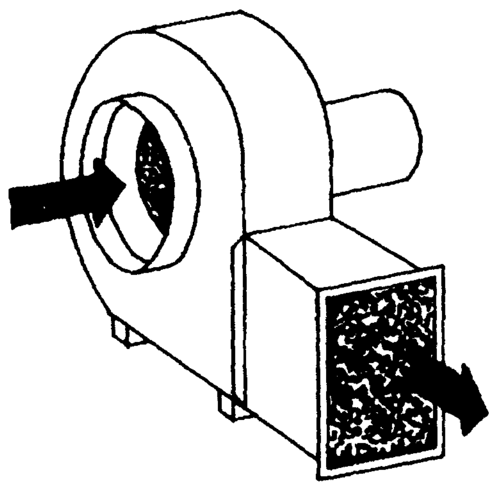


Fig. 3.1: The design of the hand blower

A well dimensioned isometric view of the required design is also given in this chapter, and Fig. 3.2 further illustrates how the air that goes into the machine is manipulated.

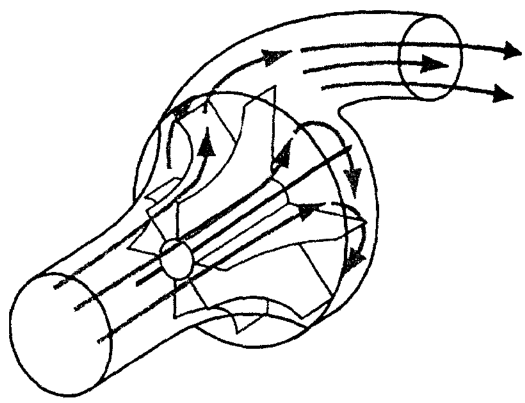


Fig. 3.2: Showing the direction of air flow

The positioning of the fan and how it is supposed to be driven by the motor was put into consideration in the design of the casing of the machine as shown in Fig. 3.3. This figure shows a well dimensioned diagram of the machine which houses the motor, the fan and the switch. Fig. 3.4 shows the various elevations of the machine to give a clearer picture of what the machine looks like.

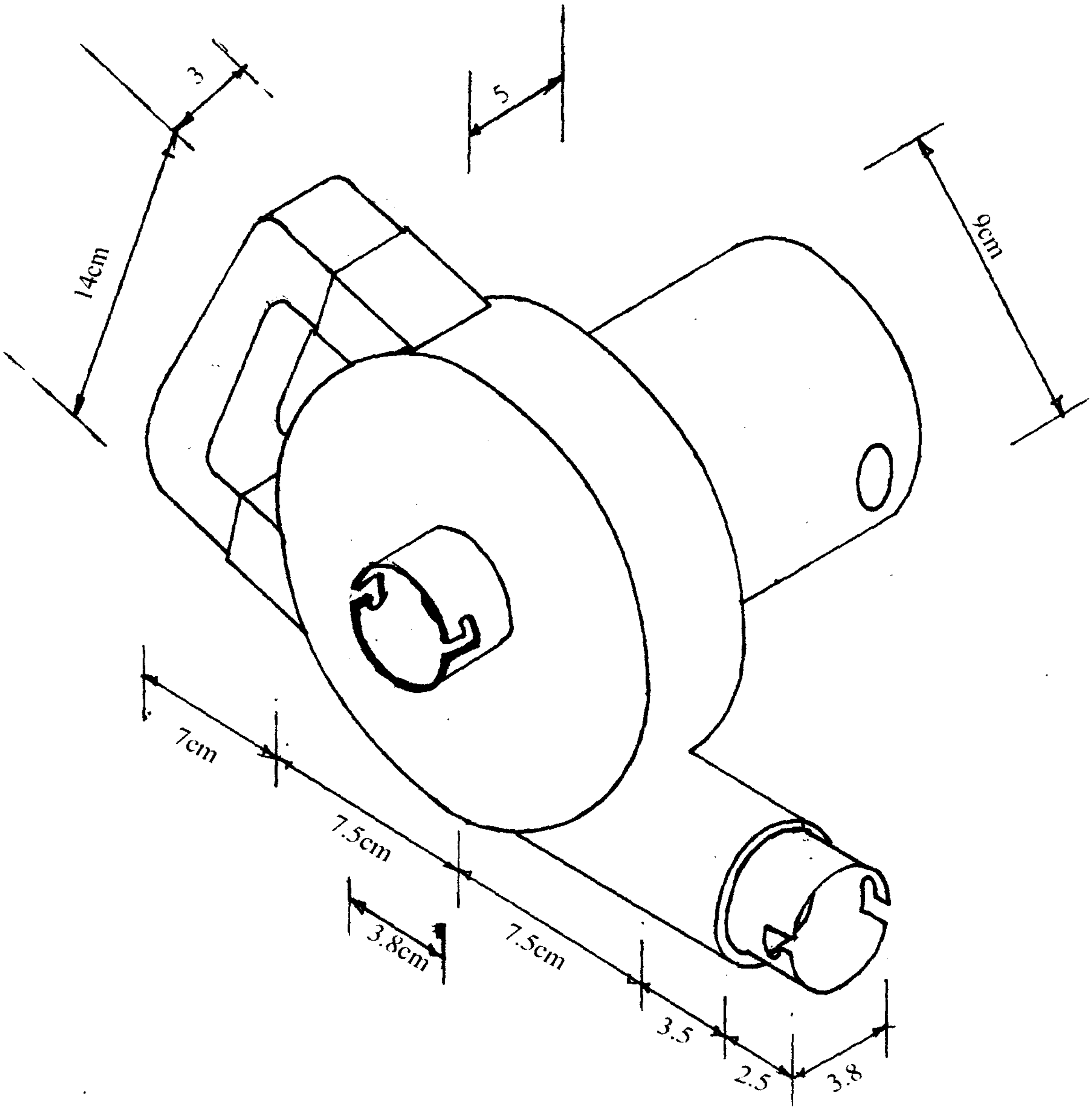


Fig. 3.3: Isometric View of the hand blower

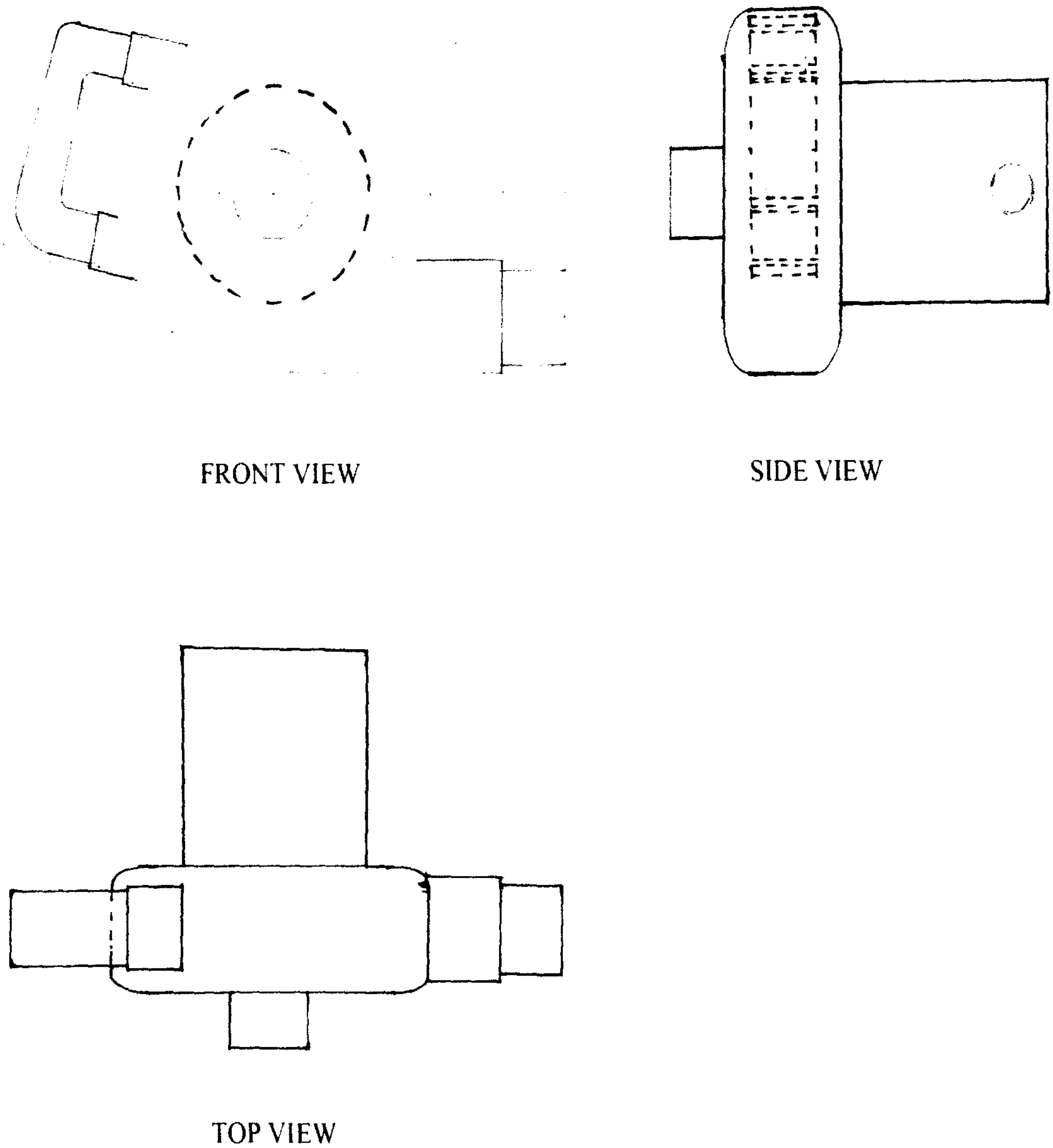


Fig. 3.4: Orthographic projection of the hand blower

CHAPTER FOUR

TESTING

As shown in the previous chapter, from the circuit diagram of the machine, the testing of this project is done by connecting the circuit to an AC power supply. Since the motor used in constructing the project is a synchronous one, when it gets excited, its rotation accelerates until it reaches its synchronising speed. At this point, the fan is expected to also rotate at this speed.

Air is sucked from one end of the machine and forced out through the other. A nozzle is attached to the part of the machine where the air is forced out. During the testing of this project, the pressure of air that was forced through the nozzle was not as high as expected.

4.1 Abnormality in the result

The abnormality noticed in the result during the testing of the project is the inability to blow air at high pressure as expected. This fault was thoroughly investigated and three possible reasons for this abnormality were;

- The low speed of the fan.
- The large diameter of the nozzle.
- Housing of the fan.
- And the choice of fan.

Attempts were made to correct these anomalies and consequently some modifications were made.

4.2 Modifications

The modifications that were made was to adjust the abnormality noticed in the result;

- No modification was made with regard to the speed of the fan; this is due to the fact that the fan will run at a speed that is equal to the speed of the motor. Since it's a synchronous motor, the weight of the fan is not large enough to affect the speed of the motor.
- The diameter of the nozzle was large and was adjusted to a much smaller diameter to increase the pressure of air that is forced out of the blower.
- I noticed that the housing for the fan was too large. For the fan to be able to manipulate air, the case is supposed to be as small as possible, so as to enable the fan to control the direction of air. In an attempt to modify this, a thick wall of hard paper was built with very small allowance from the fan and was directed to the nozzle of the case.

After these modifications, it was noticed that the pressure of air outflow was remarkably improved.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

The aim of this project was to design and construct an electric hand blower. While there are several other methods of cleaning of electrical circuits and circuit boards with respect to the maintenance of electric appliances, the use of electric hand held dust blower exemplifies itself with the distinct advantages it has over others when it comes to maintenance.

5.1 Conclusion

Having carried out successful test and investigation in this project, it is therefore convenient to conclude that the use of an electric hand held blower is the best way of handling dust in maintenance of electric circuits, computer motherboards, television circuit board and other appliances.

5.2 Recommendation for future work

Due to some of the problems that were encountered in the course of this project, some modifications were made, in other to avoid these modifications, it is recommended that:

- The forward curve fan should be used.
- The case of the blower should be as small as possible, to increase the efficiency of the fan.

5.3 Problems encounter

It is undoubtful that for such a project, challenges and problems were encountered during the course of this project. Firstly, getting the require motor with its specification was a problem. Since Minna being the town where this project was carried out is a poor commercial town, getting the motor was a problem.

5.4 Precautions

During the construction of this project, some necessary precautions were taken to ensure my safety and the success of the project. Outline of some of the precautions taken are as listed below;

- The motor's voltage rating is 230 volts, 50 Hz, so proper insulation was ensured in areas needed, particularly, in casing the motor, the introduction of plastic for housing the motor was necessary. This is to avoid any contact between the rotor and the stator. The only contact that can exist between them is through the brusher, which helps in exciting the rotor when current is passed. Any other contact will cause shocks or even sparks which may eventually blow the machine.
- Choice of the cable that was used in the project was carefully chosen since the project involved the use of an electric motor.
- I ensured that all connections were very tight and well insulated.

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