DESIGN AND CONSTRACTION OF A SIMPLE AIR BLOWER

BY

NIWAND INDA JOHNSON

17 / A/BSCED/1506/F

DEPARTMENT OF PHYSICS

A PROJECT REPORT SUBMITTED TO THE FACULTY OF EDUCATION FOR THE STUDY LEADING TO THE PROJECT IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE AW ARD OF THE

BACHELOR'S DEGREE OF SCIENCE WITH

EDUCATION AT KABALE

UNIVERSITY

SUPERVISOR: MR. OPIO PHILLIP.

DEPARTMENT OF PHYSICS FACULTY OF EDUCATION

KABALE UNIVERSITY

DECEMBER, 2020

DECLARATION

I, Niwandinda Johnson declare that this is my original work and has never been presented in any institution in Uganda for the award of bachelor in education secondary for Kabale University

Signature: ..... ~.~....

Date: 14/12/2020

.

APPROVAL

This certify that, this project work has been carried out by Niwandinda Johnson entitled "design and construction of a simple air blower".

He has been under my supervision and the project work is now ready for submission to the academic board of Kabale University with approval for the award of Bachelor Science with Education.

Signature: .....-~-

OPIO PHILLIP

Date:06/05/22\ -~-.

DEDICATION

I dedicate this project to my beloved My father Mr. KYARIKUNDA GAD, my mother; Mrs. NINSIIMAENID and my brother; engineer Ndyagumanawe Simon and other brothers; James, Geoffrey and Jordan , to my sisters; pretty and Gift, to my cousin Isaac; to my teachers, Tr. Dennis, Tr. Banabas, Tr. Amon, Tr. Callist, Tr. Cortland Richard; to my supervisor Mr. OPIO PHILLIP and lastly to all my friends; Boaz, Device, Vincent, Erineriko, Martin, Simon, and to all the lecturers of Kabale University.

Thank you for loving me and May you be blessed as you read this project.

ACKNOWLEDGEMENT

Allow me thank the Almighty God for the gift of my life, Wisdom, Love, Care, protection and miracles He has extended towards my life.

I also extend my sincere appreciation to my committed supervisor Mr. OPIO PHILLIP for the proper guidance and patience he has rendered towards this project.

In the same way, I do thank all my physics lectures. Dr. Katashaya, Mr. Habakwiha Vianney Mr. Isaac Habamugishaha, Mr. Byomugabe Charles and all my mathematics Lecturers, may good God reward you abundantly.

I thank the Kabale University administration, the vice chancellor, her deputy and the entire University leaders for free and abundant internet which enabled me to do adequate research.

Allow me also to thank my parents Mr. KYARIKUNDA GAD and Mrs. Ninsiima Enid for the financial support and love they extended towards my education from the start till now.

Lastly I send my sincere thanks to my spiritual leader Rev. Gad Twinornugisha and Tr. Ngabirano Dennis who acted as my mentors and counsellors in case of any problem.

Abstract

Air blower is a fun which can move air under pressure. It is a device which increases the velocity of air when it passes through equipped impellers. They include cleaning air blowers, ventilation air blowers among others. Air blowers have long been used for a variety of domestic and industrial purposes. An air blower works by sucking in air from one side using fans and blowing it out in the other direction. This helps to direct air through various size nozzles and get desired air blowing results needed for specific purposes. We here use de motor with a circular frame and fan based arrangement to suck air from one side and push it out the other end with force. We develop circular fan blades to assemble a blower fan that allows for one side airflow with ease. We now use the blade based fan mechanism to drive the system and achieve one side airflow. The frame is constructed in such a way so as to minimize air leakage and achieve suction from one end as well as redirect this air flow through a nozzle on the other end.

Table of Contents

1.0 INTRODUCTION

1.1 BACK GROUND

An air blower is a device or equipment which increases the velocity of air or gas when it passes through equipped impellers. They are mainly used for flow of air or gas required for cleaning, cooling, ventilating, among others. The air flow generated is used for different purposes like deaning blowers, vacuum cleaner, air conditioner, etc. Depending on application requirement, **air** flow and pressure may vary. An air blower works by sucking in air from one side using fans and blowing it out in the other direction. This helps to direct air through various size nozzles and get desired air blowing results needed for specific purposes.

1862, Guido Bell from England invented centrifugal blower. The impeller, casmg were concentric circular; the casing was made from bricks, while wooden impeller was backward straight blade. 1880, for mine ventilation, some engineers designed centrifugal blower fun with volute casing and backward curved blade.

Existing air blowers are categorized into two: axial and centrifugal. Axial air blowers, blow air axially with low pressure and has high noise level. For these reasons, axial air blowers are not commonly used. Centrifugal air blowers generally use centrifugal force to propel air forward. Inside a centrifugal air blower is a wheel with small blades on the circumference and a casing to direct the flow of air into the center of the wheel and out toward the edge. Centrifugal air blowers are capable of generating relatively high pressures. They are suitable for high pressure applications as compared with axial blowers. The design of the blades will affect how the air is propelled and how efficient the air blower is. Blade designs in air blowers are classified as forward curved, backward-inclined, backward-curved, and radial and airfoil. Forward-curved blowers are drive devices with blades that are curved in the direction of rotation: The blower

accelerates air to a high velocity

Centrifugal air blowers used in different applications can fail in many ways. To fix failures it is important to know what causes them. The problems involved with centrifugal air blowers include, blower is too noisy, when fan performance is wrong, and fan is vibrating and when the fan fails finally there is corrosion of the air blower.

As Kabala University is concerned, air blowers, that's cooling air blowers, ventilating air bowers, and cleaning air blower used are imported, none of them is locally ma!g, Again there

is a need of invading locally made air blowers, and much as projects have been done, there is none which is of air blower.

1.2 PROBLEM STATEMENT

The need of air blowers today has increased due to the need to remove dust from computers and in offices, hair drying in saloons, air conditioning, cooling among others; however most air blowers used in most places including Kabale University computer lab are imported and relatively expensive. For that reason therefore, using physics concepts and creativity, this research project has come up with an air blower using locally available materials which may be cheaper compared to the imported air blowers and it can also be used as a teaching aid.

1.3 Objectives

1.3.1 General objective

Designing and constructing a simple air blower using some of the available local materials.

1.3.2 Specific objectives.

Determining the materials available locally that can be used as components of an air blower.

Assembling a simple air blower using the available local materials.

Testing the perfonnance of the device

1.4 Scope.

- Was done and to be used within KABALE UNIVERSITY in physics laboratory
- This research project was done from September, 2019 to November 2020.
- The air blower to be made is specifically a centrifugal air blower.

1.5 Significances

- To start up a project of constructing air blowers using locally available materials.
- To promote the knowledge of creativity among the learners.
- To be used as a teaching aid

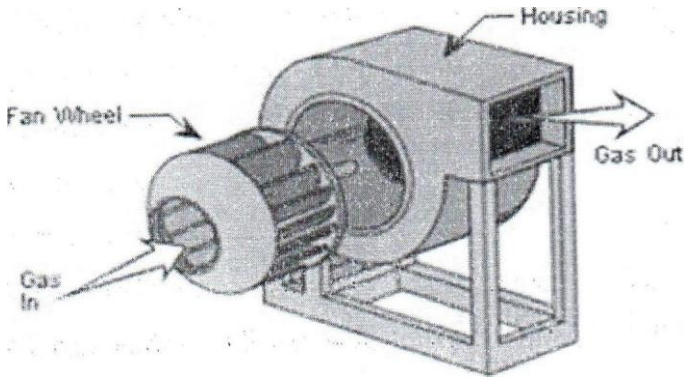
2.0 LITERATURE REVIEW

Centrifugal blowers are fundamentally high speed machines (compared with the reciprocating, rotary, or displacement type) the air flow moves a long centrifugal direction (or radial direction). Sometimes centrifugal blowers are called radial flow type blowers. **Forward-Curved Air Blowers:** A centrifugal blower with forward curved fan blades includes an inlet shroud whose shape is specifically designed for creating a smooth incoming airflow pattern that leads into the inner leading edges of the fon blades. The inlet shroud has first and second curved surfaces, wherein the centres of curvature of the two surfaces lie in the same plane, and the centre of curvature as well as the radius of curvature of one curved surface is greater than that of the other. At least one centre of curvature lies beyond the outer diameter of the impeller, and at least one centre of curvature lies beyond the impeller's inner diameter, wherein the impeller's inner diameter is defined by the inner leading edges of the fan blades. **(Smiley III, W. A., & Mehta, P. C. (2007))**

2.1 About the components and materials used in construction of an air blower.

A centrifugal blower wheel is. provided with forward-curved multi-blades comprising a pair of end rings, a plurality of blades and a disk. By separating the blades into "vane members" which assume the function of a fluid device and "vane attachment members" which assume the

function of a high speed rotating device, there is a greater degree of freedom of design, so optimum materials and shapes can be assigned to these different functions. The end rings, vane attachment members and disk are therefore constructed of metal and provided with beads so as to give a highly rigid structure, while the vane members are constructed of non-metal. This makes it possible to provide a blower wheel which is more lightweight and quieter in operation than a conventional blower wheel. **(Kobayashi, T. (1995))**



Centrifugal air blower

Components include:

- Motor
- Fan Blades
- Nozzles
- Shaft
- Suction frame
- Supporting frame and Joints

The locally available materials that were used to serve as the above parts include:

1. Compact discs
2. A piece of box
3. Sheet metals
4. Sell tape
5. Steel epoxy
6. Motor
7. Plastic bottle

The compact discs will be used for casing, and too some pieces of box. Sheets metals will be used as impellers to make the fan. Steel epoxy, this chemical will be used to a touch the part to make up the air blower. The sell tape will be used to seal the entire blower casing to ensure no air loss in the process of blowing. The motor will be used to rotate the fan when connected to the source of power. The plastic bottle will be used to design the out let of the blower.

ltha V. and Rao T.B.S (2012) The authors, in their paper, examined the choice of composites as an alternative to metal for better vibration control, used CA TIA and HYPERMESH to model the blower and analysed its strength and deformation using FEA software ANSYS. Finally, modal analysis is performed on both Aluminium and composite blower to find out first five natural frequencies.

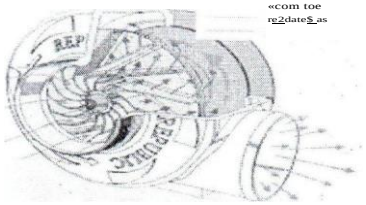
2.2. About assembling of centrifugal air blower.

Here, a de motor in a circular frame and fan based arrangement to suck air from one side and push it out the other end with force. In addition, according to **Botros, M. B.** (20%; Centrifugal blowers and fans generally include an impeller or blower wheel that rotates in a predetermined direction in a housing and which may be driven by an electric motor. The impeller has curved

1. Centrifugal air blower

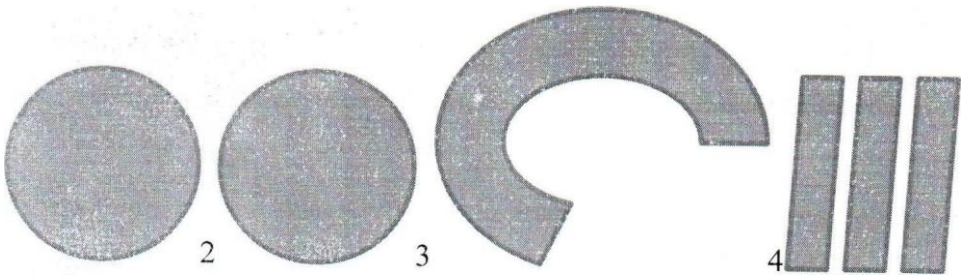
blades which draw air in axially, along the impellers' axis of rotation, and discharge air radially outwardly. Such blowers are used in a variety of applications, such as in heating and cooling systems, especially for automotive applications.

Centrifugal fans have been fitted with well-known shutter devices to reduce the opening of the air passage formed through the fan casing to control the capacity of the fan. The shutter arrangement can be closed to provide adequate airflow adjustment while, at the same time, reducing the horsepower requirements of the fan. However, with these type of shutter arrangements, fan pulsations can occur when the air passage opening is partially closed. In those cases, ,where the shutters are opened fully, the incoming air impinging on the impeller blades often results in a substantial amount of boundary layer flow separation due to the angle with which the incoming air contacts the leading edge of the impeller blades. This separation can result in increasing noise, vibration, and harshness as well as degrading the efficiency of the centrifugal blower.



In addition, on how a centrifugal air blower is assembled is as below, Shapes

of the parts of the centrifugal air blower may be as flows



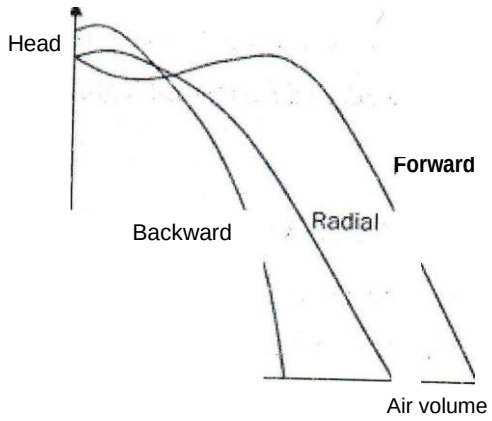
The aho ve are some the shapes of parts that I will use to make a simple centrifugal air blower especially for the housing. Shapes rebelled 1, 2, and 3, are the shapes *fm:* part::; tl:.at will be making the housing of the blower. The shapes of number 4, will be used as blades/ propellers.

Chen-Kang H. and Mu-En H. (2009) Due to their numerous applications, studies on blowers and their problems have been attracting the researchers. Here in this paper, authc-rs gave a brief introduction about the blowers and different types of blowers. They concentrated on centrifugal blowers which are commonly used for ventilation and air conditioning systems and explained about the performance analysis and optimized design of backward-curved air foil centrifugal blower. During his study, the CFD package FLUENT is used to simulate four backward curved air foil centrifugal blowers. Then the simulation results are compared with the measured results for validation.

2.3 About performance of centrifugal air blowers

, Generally centrifugal blowers have three types of blade: forward blade, backward and radial blade.

The characteristic curve of three kinds of centrifugal air blowers is as the figure.



Centrifugal biower consists of an impeller which has blade fixed between the inner and outer diameters. It can be mounted either directly on shaft extension of the prime mover or separately on a shaft supported between two additional bearing These pressure fluctuation:.; occur at flow rates when the slope of total system head curve is steeply negative. According to our previous study on the detailed unsteady pressure measurements, this pressure oscillation is supposed to be the mild surge caused by the positive slope of the head curves at the second to the last stages. The slope of the total system head curve was kept negative due to the steeply negative slope of the head curve at the first stage. Thus, the whole compression system seemed to be stable.

Explanation of Performance Tests

The main performance items of the blower are tested in the manufacturer, and the measurements of flow, air flow, pressure, shaft power and noise under the test conditions (intake temperature, atmospheric pressure, rotational speed, etc.) at that time are converted into the rated conditions to measure the specified temperature, gas density, intake pressure, rotational speed, etc.

Its performance tests are based on the following criteria: GB/T, 1236-1985 Aerodynamic Performance Test Method for blowers, JB/T 3165-1982 (Thermodynamic Performance Test for Centrifugal and Axial Flow Blowers and Compressors), ZB/J 72031-1989 "Performance Test Method for Roots Blowers for General Purpose" (Only Applicable to Specific Conditions), GB/T 1236~2000 (Industrial Opening) Standardized duct for blower performance test) and JB/T 8941.2-1999 Energy Test Method for Roots Blower for General Purpose.

The main items of measurement are:

1. Traffic

L) Measuring by throttle orifice or Pitot tube.

2) Side measuring pipes are used to measure the current collector, orifice plate or Pitot tube. The measured values of these devices can be calculated by using the formulas determined separately.

Moreover, the air volume of the blower refers to the intake air volume, which should be converted to the intake side when measuring at the outlet side.

2, pressure

Pressure is still in use with the device mentioned above, and static pressure tube (U-shaped pressure gauge)

Measurements are made by means of measuring holes oriented perpendicular to the direction of gas flow. In blowers, U-shaped pressure gauges usually use liquids such as waer or mercury. 3. Axis power

The input power of the motor is measured by a power meter. The output power of the motor is converted from the efficiency curve of the motor, and the shaft power is calculated.

4. Noise

The noise of the inlet center is measured by the indicator noise meter according to the rated state of the blower or the state close to it.

These measuring points are obtained by throttling device used in throttling test. Generally, more than 7 points are measured, of which 2 points are located before and after the most specified points.

3.0 METHODOLOGY

3.1 Introduction

In this chapter, we see the materials used during the design of a simple centrifugal air blower, which were used as components of the air blower or helped in construction. Again it talks about the methods on how the above objectives were achieved.

3.2. Testing and choosing of the materials locally available which can be used to construct a simple centrifugal air blower

In accordance to the shape, performance, and efficiency of a centrifugal air blower, I tried to test some of the materials locally available which can be used as parts of the air blower. The materials that were tested included plastics, metal, glass, wood, and epoxy, pieces of papers.

The locally available materials that were tried include:

1. Compact discs
2. Piece of box/papers
3. Seal tape
4. Steel epoxy
5. Sheet metals
6. Empty plastic bottle
7. DC motor
8. Glass
9. Wood

These are the pictures of some materials

Tools that were used in the process of construction include;

A maker; which was used to mark during measuring the required lengths.

Metre ruler; this was used for measuring length.

A pair of scissors, which was used in cutting sheet metal or any other material. **A piece of plastic,** for mixing and applying of epoxy, among others.

3.2. Design of forward curved centrifugal air blower as per Fundamental Concepts This design procedure was based on the fundamental principles of fluid flow with continuity. The design follows the path from suction to discharge. To accelerate the flow at impeller inlets, converging section is designed after inlet duct. Energy balance is established at blower inlet, intermediate stage of impeller and outlet stage of scroll casing.

Below are the procedures I took as I was constructing a simple centrifugal air blower.

3. Having collected the locally available materials as they are shown above, I started working on the sheet metals by measuring the required length and width of the impellers were made, and then I cut the sheet metals into impellers using a pair of scissors.
4. There after getting the impellers, I then attached them to one another to fonn a fun. This was done with the help of steel epoxy.
5. Thirdly, I got my DC motor and again using steel epoxy, I attached the compact disc with its rotating part passing through the hole of the compact disc.
6. At this stage, I connected the DC motor with the fan made during procedure 2 to make a propelling Shafter.
7. I now worked on the housing/ casing of the air blower. This was done from use of a piece of papers in form of a ring which is cut at one point. It is at this point that; the outlet of the blower will be. This ring like piece of papers is connected with a compact disc with the use of epoxy.
8. Then the casing made was then connected to the compact disc from where the DC motor is connected. This was done in the way such that, when connected, it covers the blower fan and ensure that as the fan rotate, it should not collide with the casing which may reduce

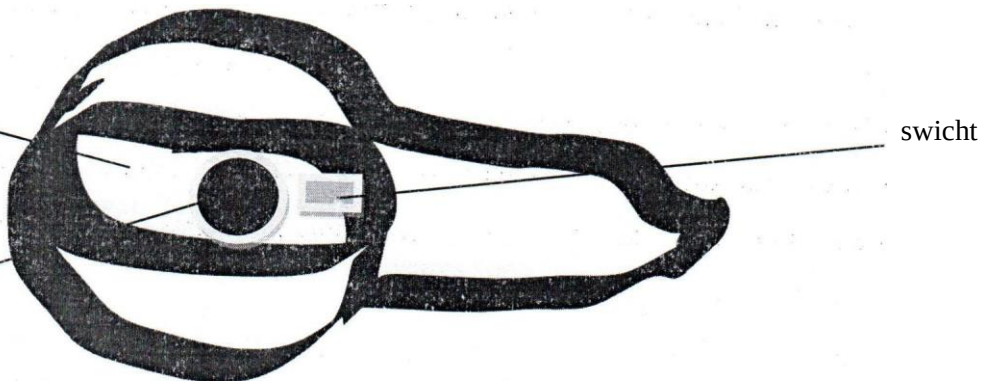
its rotating speed. The hole on the compact disc fonning the casing is used as the inlet of the blower.

7. At this stage, I masked the blower using sea tape to ensure that there was no any point of air losses during blowing particularly.

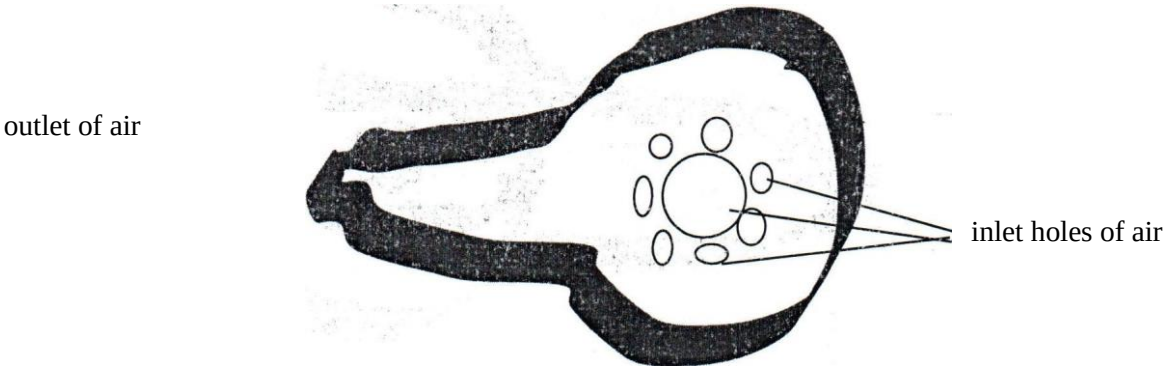
7. Finally, I attached the handle of the blower and connected the switch which is used to connect and disconnect power during use of the blower. At this time, I also connected the terminals that are connected to the battery, and painted my model to look nice.

Diagrams showing the outer parts of the constructed blower

SIDE A



SIDEB



3.3 How the performance of the air blower to be constructed will be tested.

❖ Testing the functioning of the rotating shaft.

This was done by connecting motor to the battery, when the motor is connccted to the battery, **we** expect the shaft to star rotating and for that matter, the impellers will exert potential and kinetic energy on the incoming air.

❖ Testing the inlet of the blower.

This was done using leaves of paper, they will be held near the inlet and since they are light, as blowing is in process, the leaves of paper will be attracted to the blower indicating that air is entering through that very inlet.

❖ Testing the outlet duct.

On testing the out let duct, here the velocity of air at the outlet was measured against the voltage supplied to the blower. The measuring of the air velocity was done using with the application called ZephyrFree Wind Meter, and it measures speed of wind in meters per second (m').

The voltage was measured with help of DC power supplier which supplies voltage varying from 0-12 volts.

Procedure of measuring the performance of the blower.

• Dc supplier was connected to the source of power and set to 2v output. e Air blower was connected to the de power supply.

- The outlet of the blower was placed at the phone exactly at the hole of phone microphone.
- Then, the circuit of the blower was completed by pressing the switch. This is done for 30s.
- The reading of air speed at the outlet in ms' were taken. This done with ieip of phone application called ZephyrFree Wind Meter.
- The procedures were repeated with voltage of 4v, 6v, 8v, I Ov, and 12v.
- The results were then fed into the table.
- Finally, a graph was drawn.

4.0 FINDINGS/ RESULTS AND DISCUSSION OF RESULTS

4.1 RESULTS

In this chapter, we shall see all that happened in process of designing of this forward centrifugal air blower, and also will convey the outcome of project.

4.1.1. What have been found out in the testing for the materials locally available, construction and designing of this forward curved centrifugal air blower.

Materials

Different types of materials were tested of these included metals, plastics, glass, pieces of papers, etc. It has been found out that metals and plastics can work better.

Plastics can be used on constrnction of the outer shape because they are easily shaped and the metals used for marking the fun since they can easily be curved.

Design and construction

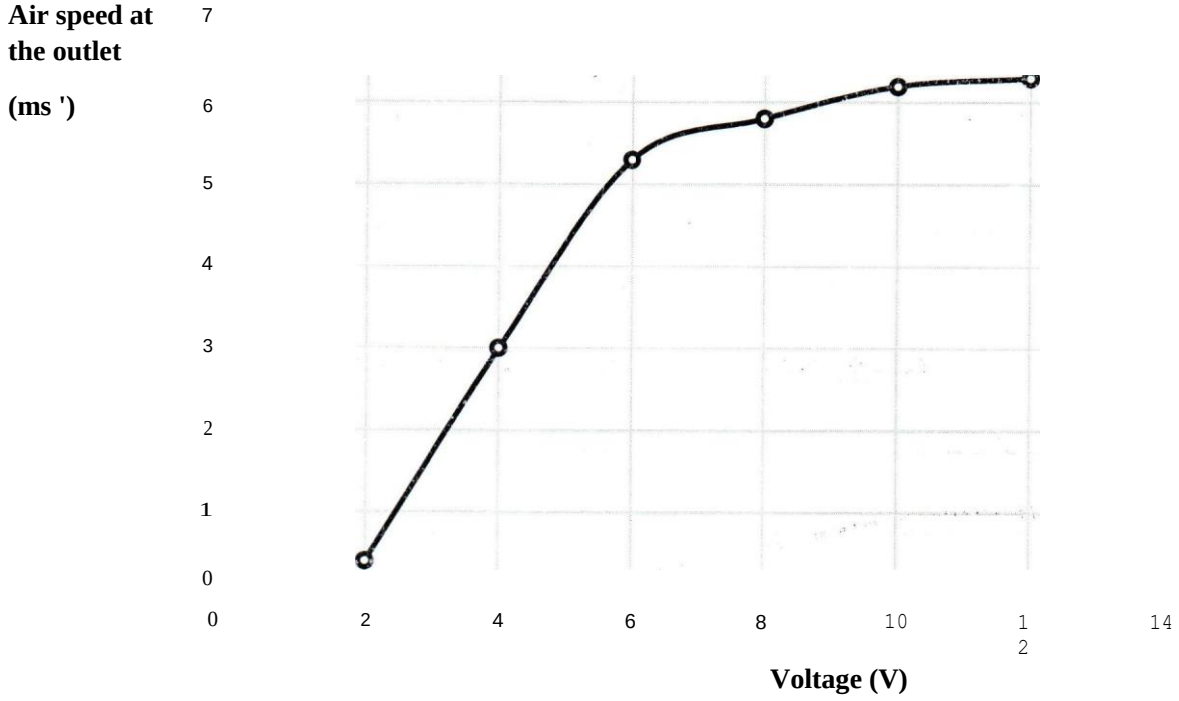
A simple air blower has been successfully constructed using locally available 1zteials as they were mentioned above and it can function very well.

4.1.2. Results for the performance of this blower

The table of results

Voltage (v)	Air speed at the outlet (ms')
2	0.4
4	3.0
6	5.3
8	5.8
1	6.2
12	6.3

A graph of Air speed at the outlet against voltage



4.2. DISCCUSSION OF RESULTS

From the testing of the performance of the which was done on the velocity of air at the outlet of the blower, we are able to observe that;

From the graph we see that, at start when voltage was low as 2v, the speed of air was also very low as0.2ms'. As voltage was increased from 2vto 4v to 6vup to 8v, the speed cf air gradually increased, thus voltage was proportional to the speed of air.

As voltage was increased from 8v to 1 Ov up to 12v, the rate of change in speed of air reduced. This means that, at a certain point, the speed of air at the outlet will remain constant with increasing voltage.

4.3. CONCLUSION

Materials; here, I conclude saying that, plastics in conjunction with metals can make a very good forward curved air blowers.

Performance; under performance, we can see that the air speed at the outlet increased with increase in voltage. There for the voltage can always be increased depending on the speed of air required for a given task.

Also, *it* was observed that at a certain point, the speed of air remains constant with increase in voltage, this may be as result of the de motor, which has a certain number of revelations per second. Therefore, a de motor of increased revolutions can be used for more effectiveness of the blower.

5.0 THE FUTURE SCOPE

The need of future scope is due to the fact that, though my model is functioning, it is not all that efficient as I expected it to be as I was staring on it.

I therefore declare a future scope which will require the researcher to investigate on how to increase the effectiveness/power of the locally constructed air blower where the locally available materials are used. Increasing effectiveness may be tried by using a de motor of increased revolutions or may also change the position of inlet of air.

REFERENCES

1. Numerical Design and Parametric Optimization of Centrifugal Fans with Air foil Blade Impellers AtrePranav C. and ThundilKaruppa Raj R. School of Mechanical and Building Sciences, VIT University, Vellore-632014, Tamilnadu, INDIA.

2. A numerical Study on the Acoustic Characteristics of a Centrifugal Impeller with a Splitter Wan-Ho Jeonl 1 Technical Research Lab., CEDIC Ltd., #1013, Byuksan Digital Valley II, Kasan- dong.

3. Evaluation of Static & Dynamic Analysis of a Centrifugal Blower Using FeaMohdJubairNizami, Ramavath Sunman, M.GuruBramhananda Reddy,International Journal Of Advanced Trends in computer science and engineering.

4. Samson, A.1987.Design and Perfonnance evaluation of Centrifugal blower for mist blower. Unpublished M.Tech Thesis, IIT, Khargpur.

5. Church, Austin H.1962.Centrifugal Pumps and Blowers, John Wiley & Sons, UK. 6.Nomura, T. (2005).

US Patent No. 6,881,031. Washington, DC: U.S. Patent and Trademark Office.

7.Smiley III, W. A., & Mehta, P. C. (2007). *U.S. Patent No. 7,186,080.* Washington, DC: U.S. Patent and Trademark Office.

8.Kobayashi, T. (1995). *U.S. Patent No. 5,476,365.* Washington, *DC;* US. Patent and Trademark Office.

9.Huang, C. K., & Hsieh, M. E. (2009). Performance analysis and optimized design of backward-curved airfoil centrifugal blowers. *HVACR Research, 15(3),* 461-488.

l O.Itha, V., & Rao, T. B. S. (2012). Static and Dynamic Analysis of A Centrifugal Blower Using Fea. *Mechanical Engineering Department, Nimra Institute of Sc;nce and Technology, Ibrahimpatnam, Vijayawada, Andhra Pradesh, India.*

11.Botros, M. B. (2000). *US Patent No. 6,092,988.* Washington, DC: U.S. Patent and Trademark Office.

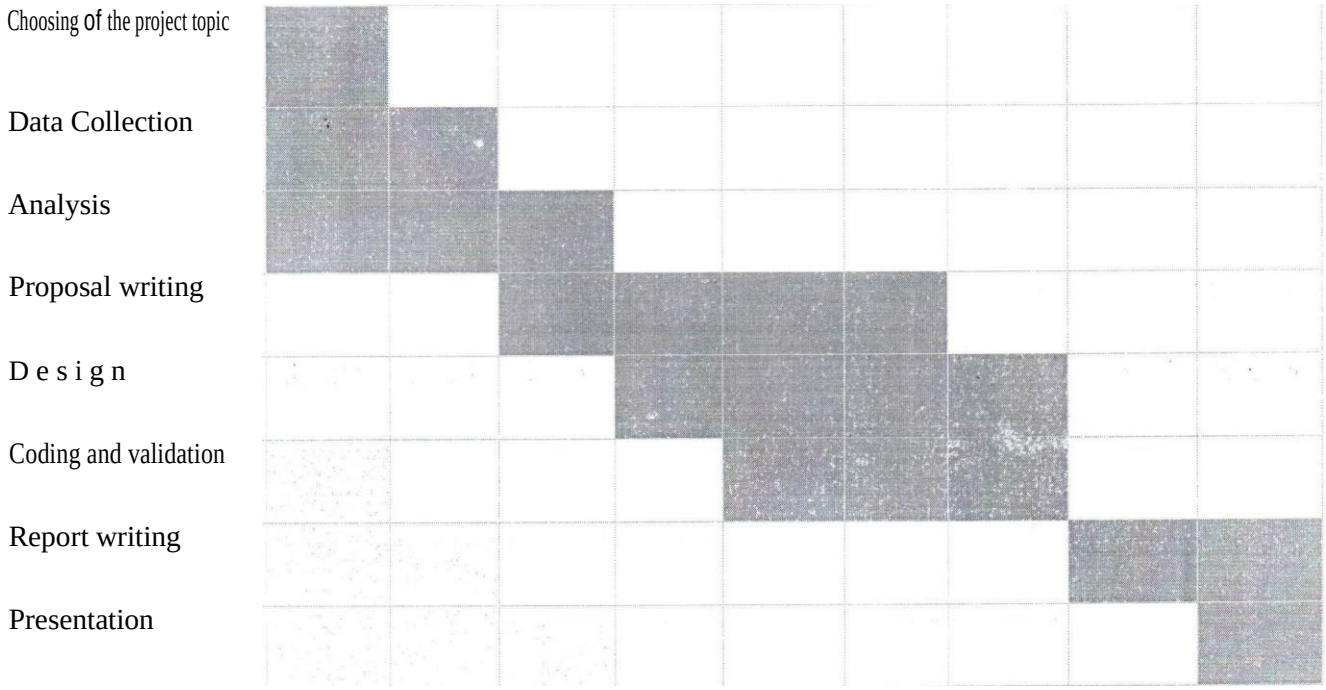
12Chunxi, L., Ling, W. S., & Yakui, J. (2011). The performance of a centrifugal fan with enlarged impeller. *Energy Conversion and Jvlanagement,* 52(8-9), 2902-2910.

APPENDICES

Appendix 1: Time budget chart

Activity R e q u r e d T m e

SEPT OCT NOV DEC JAN FEB MAR· 0 CT NOV



Appendix 2: Budget for the proposal

	ITEM	QUANTITY	UNIT PRICE(shs)	AMOUNT(U s±is)
1	A[1]rt[1]me	20'000	2000	20,000
2	FIash drive	1	25000	25,000
3	Transpoort			50,000
	Internet bundles	3 GB	2000	10,000
5	Others			50,000
6	Printing and binding Stat[1]onery	2 ream	12000	50,000
	TOT AL AMOUNT			205,000/