# EXPERIMENTAL INVESTIGATION OF ELECTRICAL-TRUST AERO ENGINE

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***Abstract-*** The E- thrust engine is a pure electric engine specifically devised for the aerospace industry which has mechanical components and powered by only electricity. The engine eliminates the use of fossil fuel for propulsion and brings us into the age of electric propulsion. The only thermal related topic would be the use of heat transfer alone. The engine comprises of various standard and available components which will be able to produce enough thrust to accelerate an aircraft of suitable size. By using this type of engine it provides a non-polluting vehicle, new renewable technology, various methods of power generation and paves a new way of utilizing nature's wonders. The reason for suggesting to move into the electric age is due to the emergence of a serious threat that would end life on earth at a faster pace. So, to stop global warming and increase of hazardous emissions from various vehicles, we suggest electric engines, since they have no emissions and doesn't pollute the atmosphere. The elimination of combustion of fossil fuel will finally get rid of the emission problem and also help us to retain and stabilize the natural resources. This new electric propulsion system and the use of solar, wind, bio fuel as source of power will help in realizing that multiple power systems are possible and applicable. Hence the E-THRUST AERO ENGINE will be the stepping stone for progressive research for future electric propulsion systems in every field of transportation. So, to survive for another century without cataclysm nature must be harnessed to our needs.

***Keywords-*** *Chord, DC Electric generator, Axial Compressor, Trust Engine*

## I. INTRODUCTION

The history of civil aviation in India began in December 1912, with the opening of the first domestic air route between Karachi and Delhi. This was by the Indian state air services in collaboration with the imperial airways, UK. Three years later the first Indian airline, Tata sons Ltd., started a regular airmail services between Karachi and Madras without any patronage from the government at the time of independence, the number of air transport companies, which were operating within and beyond the frontiers of the company, carrying both air cargo and passengers was nine. It was reduced to eight, with orient airways shifting to Pakistan. These airlines were: Tata airlines, Indian National Airways, Air service of India, Deccan Airways, Ambica Airways, Bharat airways and Mistry airways. In early 1948, a joint sector company, Air India International Ltd., was established by the government of India and Air India with a capital of Rs 2 crore and a fleet of 3 Lockheed constellation aircraft. Its first flight took off on June 8, 1948 on the Bombay- London air route. At the time of its nationalization in 1953, it was operating four weekly services between Bomba-London and two weekly services between Mumbai and Nairobi. The joint venture headed by J.R.D. Tata, a visionary who had founded the first India airline in 1932 and he himself piloted its inaugural flight. The First World War soon interrupted any progress of aviation in India for a while. Two Indians distinguished themselves in this war. Inder Lal Roy joined the royal flying corps in April 1917 at the tender age of just over 18 years. After receiving his training and the King's commission, he joined No. 56 squadron in France but was shot down in December. He was given up for dead but gained consciousness. After recovery he returned flying and shot down nine German planes before losing his life in his last air combat. He was posthumously awarded the Distinguished Flying Cross, the first Indian to receive the honor.

The other famous Indian pilot was Sardar Hardit Singh Malik, who HD also joined in April 1917. He was wounded in November but returned to flying in time for the defense of London. The royal air force inaugurated its first station in India at Ambala. But the Indian Air Force was launched by an act of the governor general on October 8, 1932. The A flight of No.1 squadron came into existence on April 1, 1933 under the command of an RAF officer on deputation. Its senior most Indian officer was pilot officer Subroto Mukherjee who later became IAF's first Indian commander in chief as an Air Vice Marshal and then took over as the chief of Air Staff as an Air Marshall. His successor was war air marshal (aspy) engineer. Aspy engineer had started his flying carrier rather early. He and RN Chawla were the first Indians to fly a De Havilland Moth from India to England. They left on March 3 and arrived on march 20, 1930. Aspy's return flight from England was to contest for the Aga Khan prize of £ 500 for flying between the two countries in either direction. JRD Tata took off in a gypsy moth on May 3 from Karachi for England. They crossed each other at Aboukir in Egypt where Aspy was in trouble due to problems with some spark plugs. JRD helped him out. Aspy arrived in India when JRD had just reached Paris. Presumably because he took longer, JRD Tata came second to Aspy who won the prize. But JRD was never a loser. After protracted negotiations with the Government of India, he started his airmail service under the name of Tata aviation, later to become Air India. He piloted the\ first carriage of mail from Karachi to Bombay on October 15, 1932. The initial efforts at passenger carriage in India were limited to British owned airlines. But as the need for more air travel facilities became paramount, permission was given to almost anyone who wants to start an airline.

This resulted in a profusion of quick start airlines, which competed with each other perhaps by cutting fares and downtime for maintenance. Eventually the Air Corporation act of 1953 was passed nationalizing all airlines. Air India international took over the international traffic and Indian Airlines Corporation the domestic. While the two national airlines still operate, the domestic scene changed recently once again as a result of economic reforms. The prospects of passenger and cargo traffic in India can only be described now as rosy. Meanwhile in December 1940, Seth Hirachand Walchand launched Hindustan Aircraft Limited with the help of an American and the state of Mysore. Dr. VM Ghatage, India's first aircraft designer soon joined the company and designedthe G-1 Glider, the first such venture in India. However, due to World War II the G-1 did not get used and Dr Ghatage became the first to start teaching aeronautical engineering at the Indian Institute of Science. He rejoined HAL after independence and designed India's first powered aircraft the HT-2. In time, HAL became a corporation with several divisions in the country. The first fighter aircraft designed in the country was the F-24 through a German team led by Prof. KW Tank largely managed it. Many aircraft types have been produced under licence and in large numbers. Lately the country has come into its own designing aircraft, engines, avionics and accessories. The success story of indigenous designs restarted with the ALH, now named Dhruv, a helicopter for all defense services and also meant for civilian use. This has been followed by the light combat aircraft and intermediate jet trainer. The prospects of aviation in India are on the right path and should gladden the heart of any aviation enthusiast.

## II. BACKGROUND AND DEVELOPMENT OF JET ENGINE

### 2.1 CONCEPT IN ANCIENT AGE

Long before humans appeared on earth, nature had given some creatures of the sea, such as the squid and the cuttlefish, the ability to jet propel themselves through the water. Many examples of the reaction principle existed during the early periods of recorded history, but because of suitable level of technical achievement in the areas of engineering, manufacture and metallurgy had not reached, there was a gap of over 2000 years before a practical application of this principle became possible.

### 2.2. THE AEOLIPILE

Hero, an Egyptian scientist who lived in Alexandria around 100 B.C., is generally given the credit for conceiving and building the first jet engine. His device, called an *aeolipile* consisted of a boiler or bowl that held a supply of water. Two hollow tubes extended up from this boiler and supported a hollow sphere that was free to turn on these supports. Attached to the sphere were two small pipes or jets whose openings were at right angles to the axis of the rotation of the sphere. When the water in the bowl was boiled, the steam shooting from the two small jets caused the sphere to spin, like the lawn sprinkler is made to spin from the reaction of water leaving its nozzle. Incidently the aeolipile was only one of many inventions credited to Hero, which include a water clock, compressed air catapult and a hydraulic organ. He also wrote many works on maths, physics and mechanics.

## 2.3. ROCKETS AS A FORM OF JET PROPULSION

*Figure1: Wan Hu's Rocket Sled*

The invention of gunpowder allowed the continued development of the reaction principle. Rockets for example, were constructed apparently as early as 1232 by the Mongols for the use in war and for fireworks displays. One daring Chinese scholar named wan hu intended to use his rockets as a means of propulsion. His plan was to lash a series of rockets to a chair under which a sled like runners were placed. Unfortunately when the rockets were ignited, the blast that followed completely obliterated Wan Hu and the chair, making him the first martyr in humanity's struggle to achieve flight. In later times the rockets were used during several wars, including the Napoleonic wars.

## 2.4. LEONARDO DA VINCI'S CHIMNEY JACK

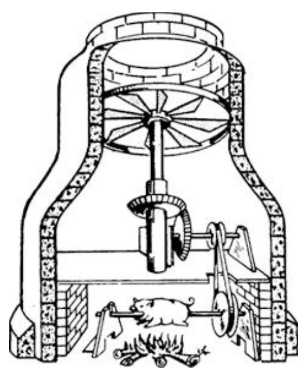


*Figure2: Chimney jack*

Around A.D. 1500 Leonardo da Vinci described the *chimney jack*, a device later widely used for turning roasting spits. As the hot air from the fire rose, it passed through a series of fan like blades that, through a series of gears, turned a roasting spit, thus indicating another application for reaction principle.

**2.5. BRANCA'S STAMPING MILL**

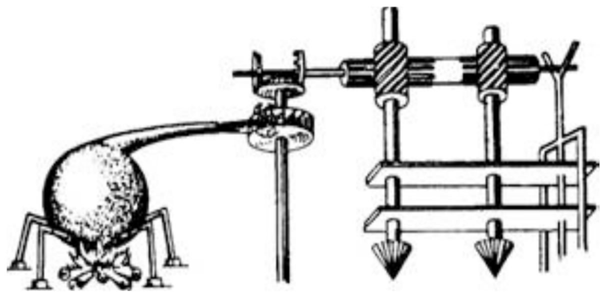


*Figure3: Blanca's jet turbine*

A further application of the jet propulsion principle, using what was probably the first actual impulse turbine engine, was the invention of the stamping mill in 1629 by Giovanni Branca, an Italian engineer. The turbine was driven by steam generated in a boiler. The jet of steam from a nozzle of a boiler impinged on the blades of a horizontally mounted turbine wheel that, through an arrangement of gearing, caused the mill to operate.

**2.6. SIR ISAAC NEWTON's STEAM WAGON**

*Figure4: Newton's steam wagon*

At this point in history (1687), Sir Isaac Newton formulated the laws of motion on which all devices using the jet propulsion theory are based. The wagon consisted of a large boiler mounted on 4 wheels. Steam generated was allowed to escape through a nozzle facing rearward. The speed of the wagon was controlled by a steam cock in the nozzle.

**2.7. THE FIRST GAS TURBINE**

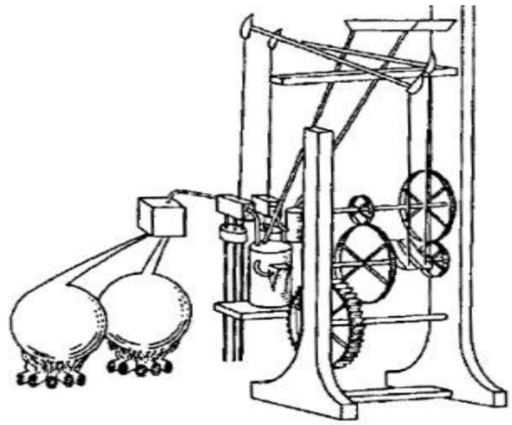


*Figure5: Barber's British patent- 1791*

In 1791 John Barber, an Englishman, was the first to patent a design using the thermodynamic cycle of the modern gas turbine and to suggest its use for propelling a horseless carriage. The turbine was equipped with a chain driven, reciprocating tube of compressor but was otherwise the same as the modern gas turbine, for it had a compressor, a combustion chamber and a turbine.

### 2.8. THE WHITTLE ENGINE

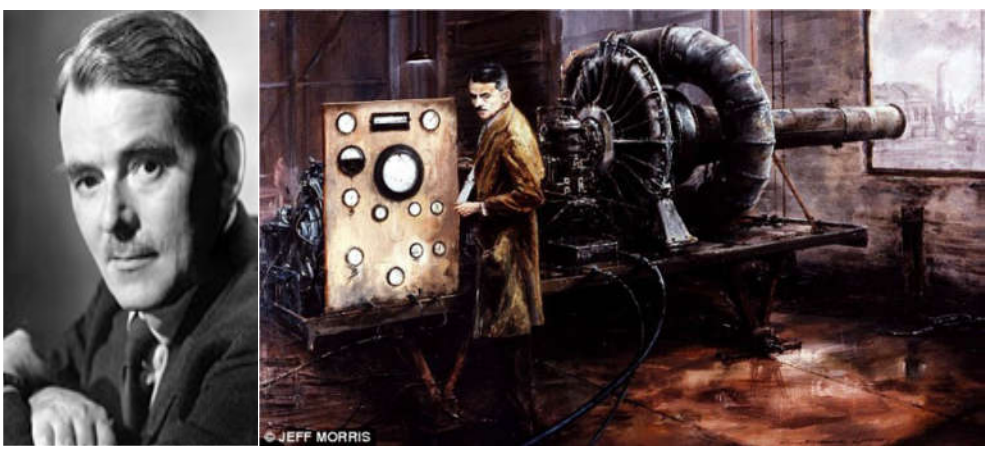



*Figure6: Sir Frank Whittle - (testing of the first prototype of the whittle engine)*

Between 1791 and 1930, many people supplied ideas that laid the foundation for modern gas turbine engine as we know it today. When in 1930 Frank Whittle submitted his patent application for a jet aircraft engine, he drew from the contributions of many people. In 1928, Whittle then a young air cadet at the royal air force college in Cram well England, submitted a thesis in which he proposed the use of gas turbine engine for jet propulsion. It was not until 18 months later that this idea crystallized and he began to think seriously about using the gas turbine engine for jet for jet propulsion. Sir Frank Whittle is considered to be the father of the modern jet engine.

## III. EXISTING CONCEPTS OF GAS TURBINE ENGINE

### 3.1 INTRODUCTION

*The forces associated with fluid movement are well known; we are familiar with the power of strong winds or waves crashing onto rocky shorelines. However, the ingenuity of mankind has enabled air and water flow, wind and wave energy to be successfully harnessed, to provide beneficial movement and power through the ages.*

*Figure7: turbine machine*

The gas turbine is a machine that burns fuel to provide energy to create a moving flow of air, and to extract valuable power or generate useful thrust from that movement. The jet engine has revolutionized air transport over the last 50 years and Rolls-Royce has been at the cutting edge, a jet engine employs Newton's law of motion to generate force or thrust as it is normally called in aircraft applications. It does this by sucking in air slowly at the front, and then blowing it out quickly at the back. Newton's third law states that any action has an equal and opposite reaction. With a jet engine, the action of accelerating air through the engine, has the reaction of forcing the engine forwards. We can use Newton's law of motion to calculate the amount of thrust the engine will generate. Accelerating air through the engine gives the air a change of momentum. Newton's second law states that the thrust is proportional to the rate of change of momentum, so: ***thrust = mass of air sucked into the engine multiplied by its change of speed.***

The jet engine is an internal combustion engine which produces power by the controlled burning of fuel. In both the gas turbine and the motor car engine, air is compressed, fuel is added and the mixture is ignited. The resulting hot gas expands rapidly and is used to produce power. In the gas turbine engine the burning is continuous and the expanding gas is ejected from the engine. This is the action applied in newton's third law, to generate thrust as the reaction. On modern jet engines the power is used to drive a large fan on the front of the engine that draws air backward and so produces thrust. The gas turbine has been adapted for power generation, marine propulsion and gas, oil pumping, all benefitting from its high power and small size.

## IV. BASICS OF AERODYNAMICS

An understanding of the basic principles of aerodynamics is as important to the aviation maintenance technician as it is to the pilot and the aerospace engineer. The technician is considered with the strength of an aircraft because of the stresses applied through the forces of aero - dynamics when the aircraft is in flight. Often responsible for the repair of the aircraft structures, the technician must know that the repair work will restore the required strength to the parts that are being repaired. There are certain physical laws which describe behaviour of airflow and defines various aerodynamic forces acting on a surface. These principles of aerodynamics provide the foundation for a good understanding of what may be termed as" theory of flight"

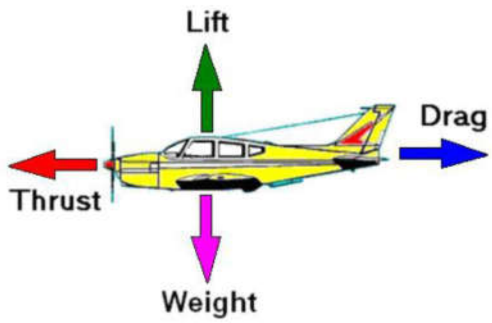



*Figure8: BASICS OF AERODYNAMICS*

The study of moving air and the force that it produces is referred as aerodynamics. As studied by the engineer or scientist, aerodynamics involves the use of advanced mathematics and physics; however this chapter presents only the basic principles of the subject and their application to the flight of aircraft, without the necessity of advanced mathematical analysis.

### 4.1 AIRFOIL TERMINOLOGY

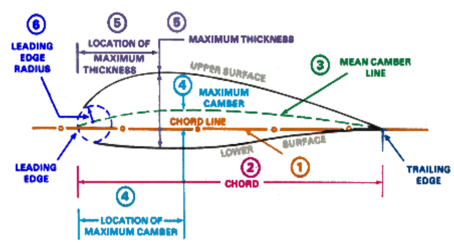



*Figure9: AIRFOIL TERMINOLOGY*

**CHORD LINE:** It is a straight line connecting the leading edge and the trailing edge of the air foil.

**CHORD:** The distance between the leading edge and the trailing edge is referred as chord.

**MEAN CHAMBER LINE:** It is the line drawn halfway between the upper and lower surfaces. It is also
referred as man line or mid line.

**MAXIMUM CHAMBER:** It is the maximum displacement of the mean line from the chord line.

**MAXIMUM THICKNESS:** It is the location of maximum thickness expressed as fractions of the percentage of
the chord.

**LEADING EDGE:** It is the radius of curvature given the leading edge shape.

## V. PROPOSED CONCEPT INVOLVING

### 5.1 Basics of Electric Motors

Electric motors are essentially inverse generators: a current through coils of wire causes some mechanical device to rotate. The core principle underlying motors is electromagnetic induction. By Ampere's law, the current induces a magnetic eld, which can interact with another magnetic eld to produce a force, and that force can cause mechanical motion. A motor is basically a generator run backwards (using current to produce motion rather than motion to produce current), and in fact the modern era of practical motors was initiated by accident when one DC generator was accidentally connected to another in 1873, producing motion and leading Zenobe Gramme to realize that his generators could also be used as motors. The rst AC motors (synchronous and then induction) were invented by Tesla in the 1880s. Electric motors are estimated to now consume over 25% U.S. electricity use (though some estimates are even higher, to up to 50%, and over 20% of U.S. total primary energy).

While large electric motors can be extremely ancient at converting electrical energy to kinetic energy ( > 90%), those sciences are only achieved when motors are well-matched to their loads. Actual sciences in normal usage practice in the U.S. are substantially suboptimal (motors are oversized for the loads they drive). Small electric motors are also inherently less ancient (more like 50%). Motor design and, even more importantly, motor choice and use practices are an important area of potential energy conservation.

**This reading is a (very brief) introduction to four most basic types of electric motors:**

Brushed DC
Brushless DC
Synchronous AC
Induction

Like generators, electric motors consist of a stator and a rotor and the three ingredients: electric current, magnetic ends, and something rotating. A basic rule of thumb is that in an AC motor, as in an AC generator used for industrial power production, the magnet is on the rotor and the current owns in the stator. In most DC motors, the magnet is in the stator and the current is owing in the rotor; hence the need for brushes. 26

Motor specification usually involve several quantities: the voltage (or range of voltages, for DC motors) that the motor can be run at, the rotor speed (or range of speeds), the electrical power drawn by the motor (often given in horsepower rather than Watts), the \torque" or elective turning force of the motor (discussed further below). Modern motors span a wide range of all these quantities. In particular motors can span 8 orders of Magnitude in power consumed. Tiny DC motors of the kind used in toys are a few Watts in power; big AC hydro generators that are also run backward as motors to pump water can be over 100 Megawatts. (For more comparison of motors in daily life: the motor in a household power tool is often 1/4 hp (< 200 W) (though they take much more power when starting up); a ceiling \ or our fan is < 100 W; the compressor in an air conditioner is > 1000 W). Torque is a useful concept when describing forces that produce rotation rather than linear motion - it's a measure of the ability of a device to turn something. Everyone has an instinctive idea of the power of a lever: if you try to move something by prying with lever (think of turning a stubborn bolt with a long wrench), you can exert more \turning force" with a longer lever than with a short one. Torque (we'll call it T) is that \turning force". In this definition and the math that follows, the bold-face means that quantities have a direction as well as a magnitude.

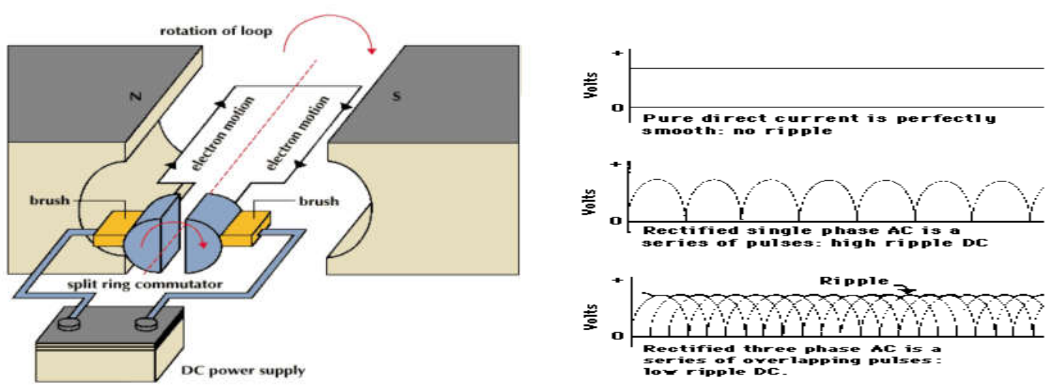



*Figure10: Dc Motor With Rotating Loop, Brushes And Split Reduction Of Torque Ripple In Dc Motors By Adding Multiple Recited Sine Waves*

## VI. AERO BATTERY TECHNOLOGY

### 6.1 Classification

Before we go into the technical details of how batteries work, it's important to note that there are two common types of batteries that account for all the batteries that CECOM manages: Primary and Rechargeable. The term "primary" was first used to describe this type based on the fact that the materials inside the battery were the prime source of the electric power it delivered, while the "secondary" (or rechargeable) batteries had to receive a charge before they could deliver any power.

### 6.2 Primary Batteries

Primary batteries are capable of one-time use: use it until it's depleted and then dispose of it. The most common primary batteries in the world today are alkaline D, C, AA, AAA and 9-volt batteries. These batteries use zinc as the anode and manganese dioxide as the cathode with potassium hydroxide as the electrolyte – the "alkaline" part of the battery.

### 6.3 Rechargeable Batteries

The oldest rechargeable battery still in use is the familiar lead-acid battery. These batteries use lead as the anode, lead dioxide as the cathode, and sulphuric acid as the electrolyte. Both electrodes are converted to lead sulphate in discharge; charging converts them back to their original materials. This is a rare case of the electrolyte actually taking part in the discharge process. This is the reason why it has been possible to determine the state of charge of a lead-acid battery by checking the specific gravity of the electrolyte. Lead-acid batteries have a specific gravity of 1.28 when fully charged and 1.12 when fully discharged. The rechargeable batteries managed by CECOM come in three chemistries: nickel-cadmium, nickel-metal hydride, and lithium ion. The nickel-cadmium batteries can have either vented or sealed cells. The former type is used in aircraft; the latter type is used for communications-electronics equipment.

## VII. ELECTRICAL-TRUST ENGINE MODELLING

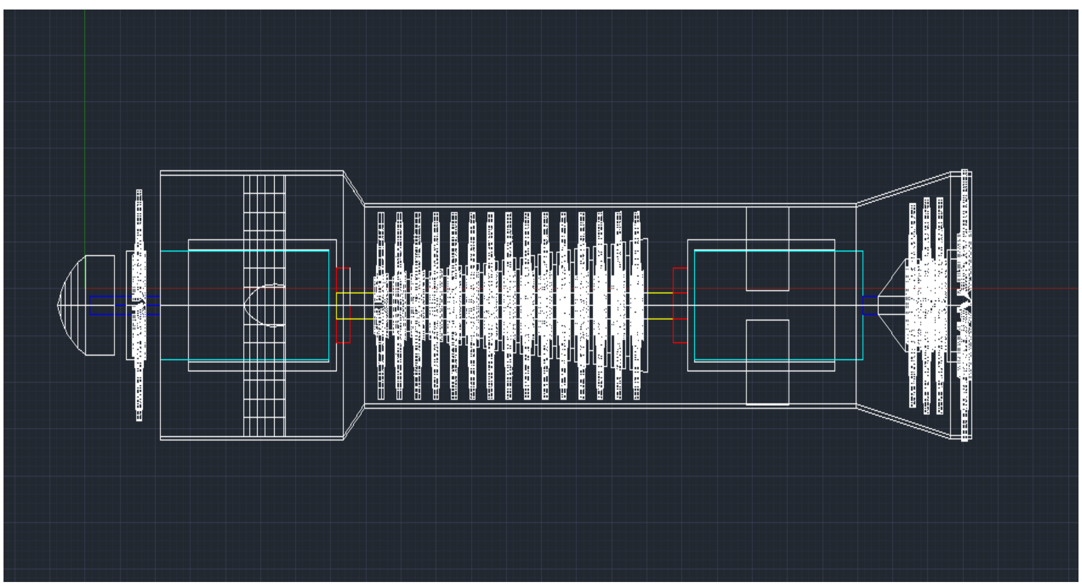


*Figure11: 2d Modelling Is Design By Using Auto-Cad 2015 Version And Each Parts Are Drawn Separately After It Assemble On Axis Based Orientation.*

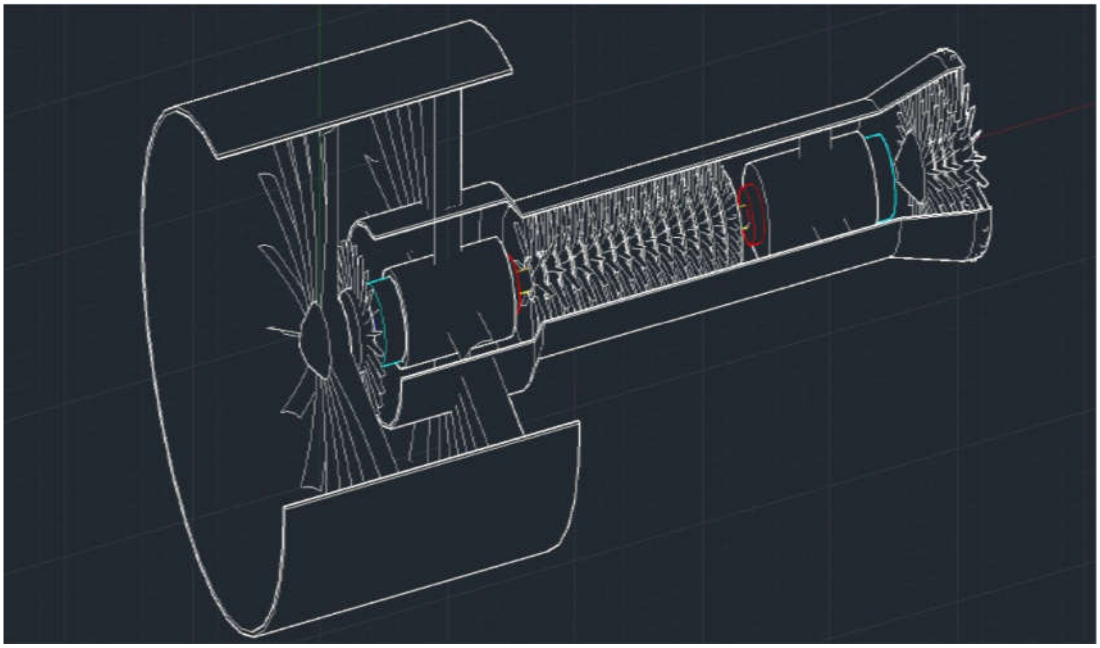


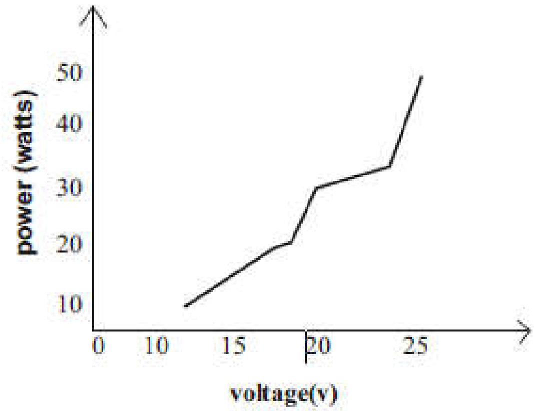
*Figure12: 3d Modelling Is Design By Using Auto-Cad 2015 Version And Each Parts Are Drawn Separately After It Assemble On Axis Based Orientation.*

## CALCULATION AND GRAPH

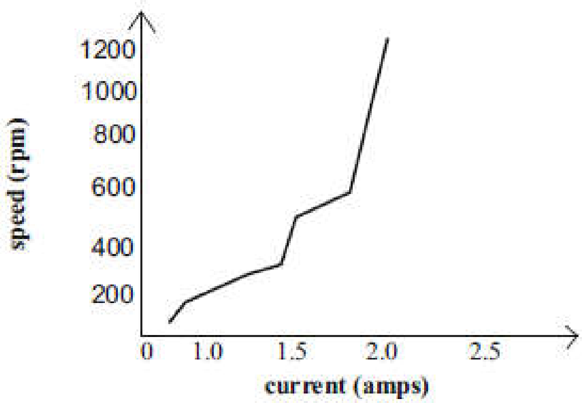
*Table1: The Dc Motor Used*

| VOLTAGE | CURRENT | SPEED | INLET VELOCITY | POWER | OUTLET VELOCITY |
|---|---|---|---|---|---|
| 12V | 0.50 AMPS | 153 RPM | 1.4 m/s | 6 W | 2.7 m/s |
| 16V | 1.20 AMPS | 206 RPM | 2.0 m/s | 19.2W | 5.8 m/s |
| 18V | 1.50 AMPS | 525 RPM | 3.7 m/s | 27W | 6.6 m/s |
| 24V | 1.90 AMPS | 1200 RPM | 6.8 m/s | 45.6W | 8.7 m/s |

graph 1




graph 2




**POWER CALCULATION**

Power = Voltage * Current
P (Watts) = V (Volt) * I (Amps)

Parallel arrangements of cells do not magically produce more power. In an electric circuit, power, measured in watts, is the product of both voltage and current. Batteries are needed to provide power, not just voltage.

1. P= V*I= 12 * 0.50= 6 Watts
2. P= V*I= 16 * 1.20= 19.2 Watts
3. P= V*I= 18 * 1.50= 27 Watts
4. P= V*I= 24* 1.90 = 45.6 Watts

## VIII. ELECTRICAL-TRUST AERO ENGINE WORKING PRINCIPLE

The engine consists of an interior core which consists of a series of compressors rather than a compressor turbine setup. The full setup is attached to a single shaft connected by means of two dual shaft motors. The motor attached between the primary compressor and axial compressor is the main driver. The motor attached between the axial or secondary compressor and the tertiary generator acts as the generator, which recharges the battery.

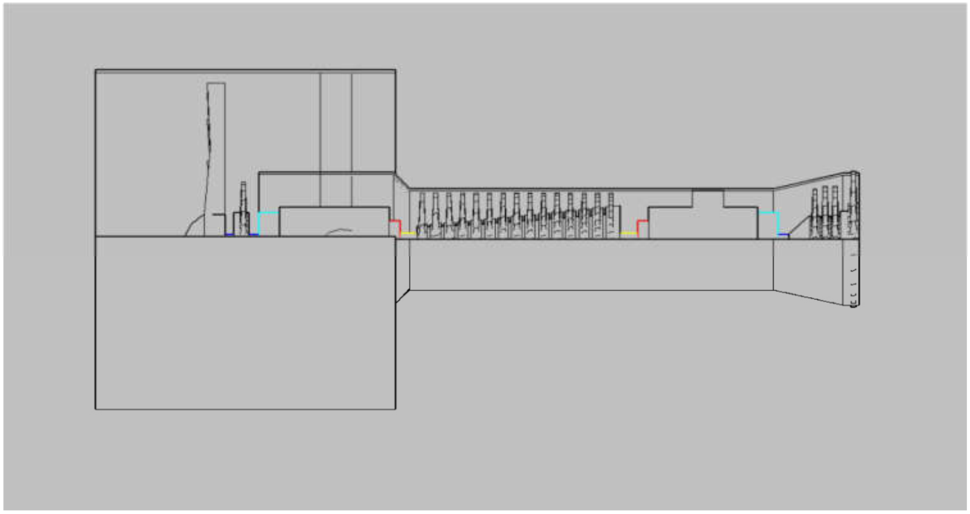


*Figure13: engine interior core*

The motor is given electrical supply which rotates all the compressors at the same time. The air is sucked through the primary compressor and split through the walls of the fan case and blow over the core. The other half of the air is blown through the core. That air is then sucked by the axial or primary compressor and highly compressed air is sent through the duct of the core and sent to the tertiary compressor. So the velocity increases as it enters the air is forced through the core. The so depending upon the power supplied to the motor the appropriate thrust can be produced. The entire setup is kept within an aerodynamic cover called as the cowl casing which regulates the airflow through the fan case. By using this principle constant supply of power is produced and required thrust can be easily produced.

## CONCLUSION

Thus the e thrust engine is successfully fabricated and made in such a way that it forms the stepping stone to create the path way for the electric age. By welcoming the electric age is meant to provide free energy, non-polluting vehicles, peace and tranquillity. So by implementation of this engine ensures the safety of our natural
Resources.

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10. *Jeff Cobb (2015-06-03). "May 2015 Dashboard". HybridCars.com and Baum & Associates. Retrieved 2015-06-26. See sections: "May 2015 Plug-in Hybrid Car Sales Numbers" and "May 2015 Battery Electric Car Sales Numbers." A total of 43,560 plug-in electric cars were sold during the first five months of 2015, consiting of 15,100 plug-in hybrids and 28,460 battery electric cars.*
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12. *Jeff Cobb (2015-06-09). "European Plug-in Sales Leap Ahead of US For The First Time". HybridCars.com. Retrieved 2015-06-14.Cumulative global sales totaled about 850,000 highway legal plug-in electric passenger cars and light-duty vehicles by May 2015.*
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