AIR ENGINE USING PNEUMATIC CYLINDER

A PROJECT REPORT

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in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

M. KUMARASAMY COLLEGE OF ENGINEERING, KARUR

ANNAUNIVERSITY: CHENNAI 600025

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BONAFIDE CERTIFICATE

Certified that this project report "**AIR ENGINE USING PNEUMATIC CYLINDER "** is the bonafide work of **"RIYAZKHAN D(927622BME071), ROHIT K (927622BME072), MUTHUSELVAN (927622BME314)"** who carried out the project work during the academic year 2023 – 2024 under my supervision. Certified further, that to the best of my knowledge the work reported here does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We affirm that the Project titled **"AIR ENGINE USING PNEUMATIC CYLINDER"** being submitted in partial fulfillment off or the End Semester Examination of **B.E. MECHANICAL ENGINEERING**, is the original work carried out by us. It has not formed the part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INSTITUTION VISION&MISSION

Vision

- To emerge as a leader among the top institutions in the field of technical education.

Mission

- Produce smart technocrats with empirical knowledge who can surmount the global challenges.
- Create a diverse, fully-engaged, learner-centric campus environment to provide quality education to the students.
- Maintain mutually beneficial partnerships with our alumni, industry and professional associations.

DEPARTMENT VISION, MISSION, PEO, PO & PSO

Vision

- To create globally recognized competent Mechanical engineers to work in multi-cultural environment.

Mission

- To impart quality education in the field of mechanical engineering and to enhance their skills, to pursue careers or enter into higher education in their area-of-interest.
- To establish a learner-centric atmosphere along with state-of-the-art research facility.
- To make collaboration with industries, distinguished research institution and to become a center of excellence

PROGRAM EDUCATIONALOBJECTIVES(PEOS)

The graduates of Mechanical Engineering will be able to

- PEO1: Graduates of the program will accommodate insightful information of engineering principles necessary for the applications of engineering.
- PEO2: Graduates of the program will acquire knowledge of recent trends in technology and solve problem in industry.
- PEO3: Graduates of the program will have practical experience and interpersonal skills to work both in local and international environments.
- PEO4: Graduates of the program will possess creative professionalism, understand their ethical responsibility and committed towards society.

PROGRAM OUTCOMES

The following are the Program Outcomes of Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary

environments.

12. **Life - long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life -long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Engineering Graduates:
The students will demonstrate the abilities

1. **Real world application:** To comprehend, analyze, design and develop innovative products and provide solutions for the real-life problems.
2. **Multi-disciplinary areas:** To work collaboratively on multi-disciplinary areas and make quality projects.
3. **Research oriented innovative ideas and methods:** To adopt modern tools, mathematical, scientific and engineering fundamentals required to solve industrial and societal problems.

Course Outcomes	At the end of this course, learners will be able to:	**Knowledge Level**
CO - 1	Identify the issues and challenges related to industry, society and environment.	Apply
CO - 2	Describe the identified problem and formulate the possible solutions.	Apply
CO -3	Design / Fabricate new experimental set up/devices to provide solutions for the identified problems	Analyse
CO -4	Prepare a detailed report describing the project outcome	Apply
CO - 5	Communicate outcome of the project and defend by making an effective oral presentation.	Apply

MAPPING OF PO & PSO WITH THE PROJECT OUTCOME

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO - 1	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 2	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 3	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 4	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO - 5	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3

TABLE OF CONTENT

ABSTRACT

The environmental pollution in the metropolitan cities is increasing rapidly mostly because of the increased number of fossil fuel powered vehicles. Many alternative options are now being studied throughout the world. One of the alternative solutions can be a compressed air powered engine. Main advantage of this engine is that no hydrocarbon fuel is required which means no combustion process is taking place. In this work a pneumatic cylinder activation is used as a linear source and with the help of crank shaft the rotational movement is obtained. The flow of air inside the pneumatic cylinder is controlled by means of valve which is actuated periodically by an electronic control unit. As we completely changed the usage of existing conventional engine to a simplified air powered one, this new technology is easy to adapt. Another benefit is that it uses air which is available abundantly in atmosphere.

CHAPTER 1

INTRODUCTION

One of the major problems most developing countries facing now a days is pollution and the major source of which is automobiles running on the roads. Concerning resource availability there has been a strong warning that petroleum resources may be depleted in the relative near future. Gasoline which has been the main source of fuel for the history of cars, produces carbon monoxide, nitrogen oxides and unburned hydrocarbons which are the main pollutants and are responsible for bad effect of pollution. There comes need to think about alternatives such as Biodiesel and Natural gas, electric cars, hybrid cars, hydrogen fuel cells but these alternative fuels also have some drawbacks. One possible alternative fuel is the compressed air. Fossil fuels (i.e., petroleum, diesel, natural gas and coal) which meet most of the world's energy demand are being depleted rapidly. Also, their combustion products are causing global problems, such as the greenhouse effect, ozone layer depletion, acid rains and pollution which are posing great danger for environment and eventually for the total life on planet. These factors are leading automobile manufactures to develop cars fuelled by alternatives energies. Hybrid cars, Fuel cell powered cars, Hydrogen fuelled cars will be soon in the market as a result of it. One possible alternative is the air powered vehicle. Air, which is abundantly available and is free from pollution, can be compressed to higher pressure at a very low cost, is one of the prime option since atmospheric pollution can be permanently eradicated. Whereas so far all the attempts made to eliminate the pollution has however to reduce it, but complete eradication is still rigorously pursued. Compressed air utilization in the pneumatic application has been long proven. Compressed air was also used in some of vehicle for boosting the initial torque. Turbo charging has become one of the popular techniques to enhance power and improve the efficiencies of the automotive engine that completely runs on compressed air.

CHAPTER 2

LITERATURE REVIEW

COMPRESSED AIR VEHICLE

The latest trend in the automotive industry is to develop light weight vehicles. Every automotive industry is looking to reduce the weight of the vehicle as it helps in the better handling of the vehicle and increases the efficiency of the vehicle. Today, the heavy vehicles are known for producing a large amount of harmful gases like CO2, SO2 etc. which act as the major source for global warming. So research is going on to find a light weight vehicle which does not pollute the environment. One of the alternatives is the use of compressed air to generate power to run an automobile. Due to the unique and environmental friendly properties of air, it is considered as one of the future fuels which will run the vehicles. So in this paper an effort is made to study the extent of research done and the potential advantages and disadvantages of the compressed air technology

Experimental Analysis of a Compressed Air Engine

Nowadays, automobiles consume a large number of fossil fuels. However, the consumption of fossil fuels has brought many serious environmental problems, such as global warming, ozone layer depletion and fine particulate matter. To avoid such environmental problems, renewable energy has been applied to automobiles. In this paper, an air-powered engine of a renewable energy vehicle is introduced. To lay a foundation for the optimization of compressed air engine (CAE), a physical model of compressed air engine (CAE) is established with cam which controls compressed air charge or discharge cylinder. To obtain performance of the CAE, a prototype CAE system is set up. The output torque, power and efficiency are obtained through experimental study. The results show that the prototype of CAE has a good economic performance under low speed and when the supply pressure is 2 MPa, the maximum output power is 1.92 kW;

the maximum output torque is 56.55 N·m; and the maximum efficiency is 25%. This research can be referred to in the optimization of air-powered engine.

Experimental Investigation of Compressed Air engine Performance

As a solution of shortage of fossil fuels and the environmental legislation, compressed air as a source of energy, which can be used in different applications such as vehicles is well known as a nonpolluting fuel has attracted scientists and engineers for centuries. Efforts are being made by many researchers, developers and manufacturers to use the compressed air vehicle technology in all respects. In this paper, an effort is made to study various modifications, merits and demerits of compressed air engine. For this purpose, a single cylinder petrol engine is tested at different operating conditions using gasoline, modified to work with compressed air and tested again. All performance, emission, noise and vibration parameters are measured at different engine operating conditions. Based on the results presented in this paper, compressed air technology is one of the best technologies and demands more attention as it tends to be eco-friendly and running on a fuel that is freely available. Even though the engines running on the compressed air seem to compare poorly to gasoline engine in range and power and their applications severely constrained due to their limited driving range, but the power to weight ratio is improved due to the reduction in engine weight. CAE will be an ideal mode of transportation if enough research and analysis are put in the field

Experimental Analysis of Pneumatic Vehicle

Present scenario of the world describes, the crisis of fuel and pollution problem, along with it, conventional sources are about to deplete in near years. So, the search on alternative fuels is on progress and in demand too. Today there are several solutions to meet demand for better economy in fuel and one of them is the concept of pneumatic-hybrids. The project focuses on a hybrid-vehicle driven

by air as alternate source to fuel and a battery driven too, to reduce the dependency on conventional sources. In this, compressed air is stored in storage tank/ compressor& pneumatic motor is used for conversion of pressure to mechanical energy. This pneumatic-hybrid vehicle is not only eco-friendly, pollution free but also very economical. An Experimental Analysis to develop a Hybrid Pneumatic Vehicle that works on compressed air. The vehicle is powered by a compressed-air engine and can be later switched to batteries. The vehicle uses a non-renewable and pollution free fuel. A Pneumatic Vehicle is a pneumatic actuator that creates useful work by expanding compressed air. When this compressed air expands, the energy is released to do work. So this energy in compressed air can also be utilized to displace a piston.

CHAPTER 3

WORKING PRINCIPLE

When the timer circuit get turned on it functions the pneumatic cylinder to extend and retract based upon the programmed time control. The solenoid valve allows the compressed air from the compressor to the pneumatic cylinder to extend it. This linear activation obtained is converted into half the rotation of crank shaft and its next half rotation is obtained by retraction of pneumatic cylinder. Due to its continuous activation a rotational movement is obtained which is stabilized with the help of flywheel arrangement and it is utilised for commercial applications.

CHAPTER 4

MAJOR COMPONENTS

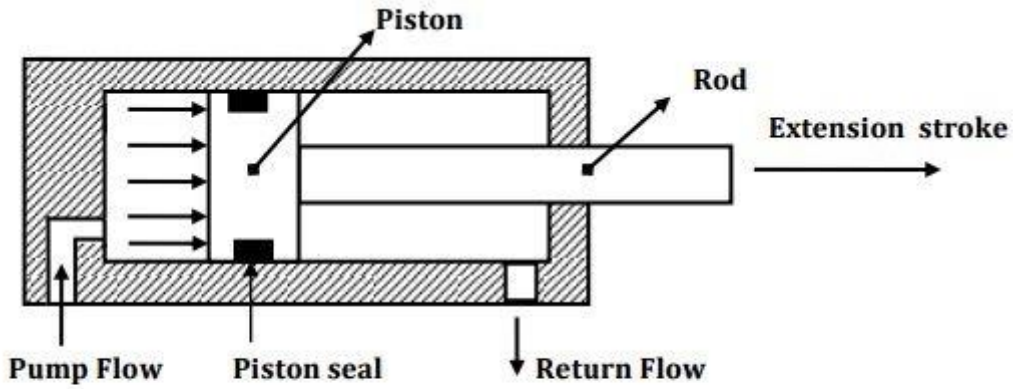
1. PNEUMATIC CYLINDETR
2. LIMIT SWITCH
3. SOLENOID VALVE
4. HOSE AND CONNECTOR
5. SHAFT
6. BEARING
7. METAL STRIP
8. FLY WHEEL
9. CRANK SHAFT
10. COMPRESSOR

4.1. PNEUMATIC CYLINDER

Pneumatic cylinders can be used to get linear, rotary and oscillatory motion. There are three types of pneumatic actuator:

1. Linear Actuator or Pneumatic cylinders
2. Rotary Actuator or Air motors
3. Limited angle Actuators

Pneumatic cylinders are devices for converting the air pressure into linear mechanical force and motion. The pneumatic cylinders are basically used for single purpose application such as clamping, stamping, transferring, branching, allocating, ejecting, metering, tilting, bending, turning and many other applications.



Double acting cylinder

To achieve forward motion of the cylinder, compressed air is admitted on the piston side and the rod side is connected to exhaust. During return motion supply air admitted at the rod side while the piston side volume is connected to the exhaust. Force is exerted by the piston both during forward and return motion of cylinder. Double acting cylinders are available in diameters from few mm to around 300 mm and stroke lengths of few mm up to 2 meter

4.2.LIMIT SWITCH

In electrical engineering a **limit switch** is a switch operated by the motion of a machine part or presence of an object.

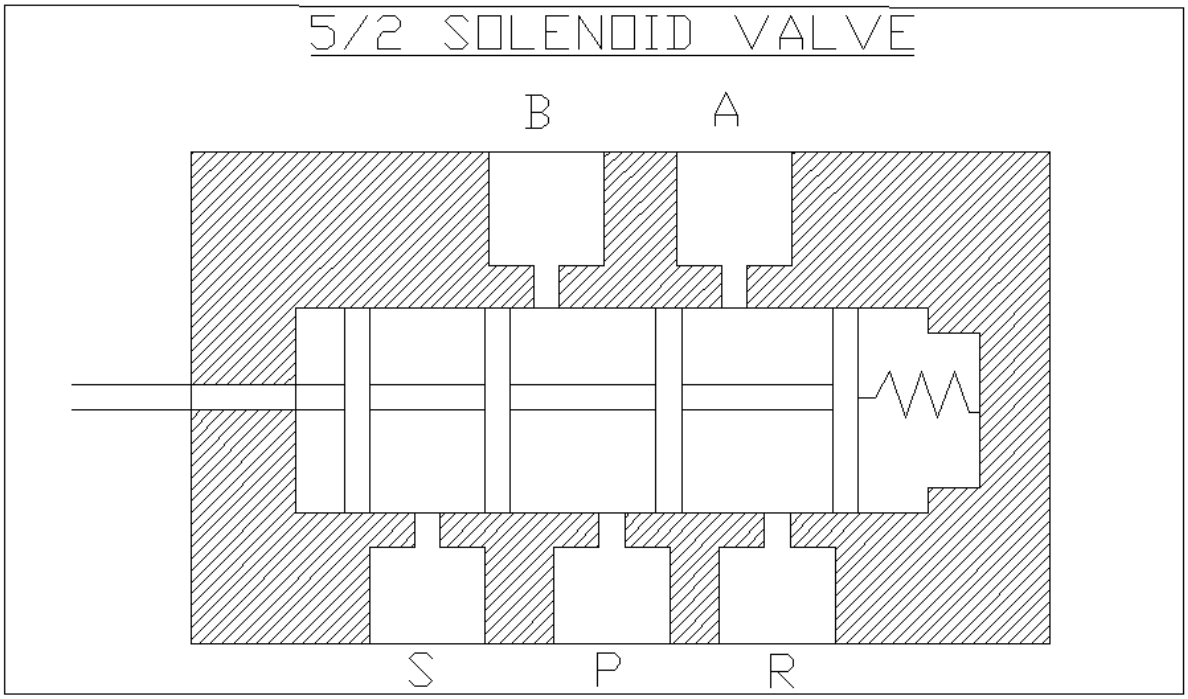
They are used for controlling machinery as part of a control system, as a safety interlocks, or to count objects passing a point.[1] A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection.

Limit switches are used in a variety of applications and environments because of their ruggedness, ease of installation, and reliability of operation. They can determine the presence or absence, passing, positioning, and end of travel of an object. They were first used to define the limit of travel of an object; hence the name "Limit Switch".

4.3.SOLENIOD VALVE

A **solenoid valve** is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

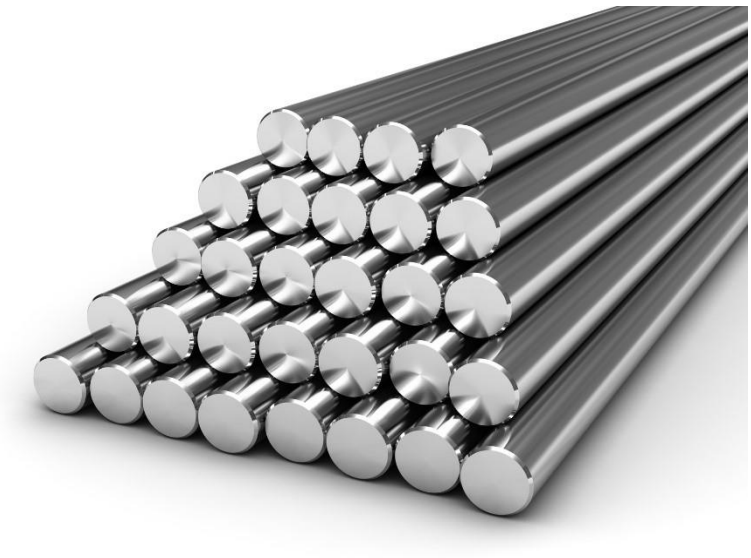
Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact



4.4.HOSE AND CONNECTER

A **hose coupling** is a connector on the end of a hose to connect (or *couple*) it with another hose or with a tap or a hose appliance, such as an irrigation sprinkler. It is usually made of steel, brass, stainless steel, aluminium or plastic.

4.5.SHAFT



Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power transmission. The shaft is generally acted upon by bending moment, torsion and axial force.

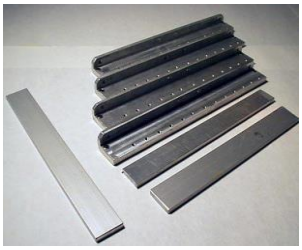
4.6.BALL BEARING

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

4.7.METAL STRIP



Metal strip is narrow, thin stock that is usually 3/16 in. (4.76 mm) or less in thickness and under 24 in. (609.6 mm) in width. Metal strips are formed to precise thicknesses and/or width requirements.

How Metal Strip is made?

Metal strip can be designed and manipulated through a large number of processes which are grouped into categories. They are joining and assembly processes, deformation processes, material removal processes, heat treating processes, and finishing processes**.**

4.8.FLY WHEEL

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by the application of a torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing the flywheel's rotational speed.

4.9.CRANK SHAFT

A **crankshaft** related to crank is a mechanical part able to perform a conversion between reciprocating motion and rotational motion. In a reciprocating engine, it translates reciprocating motion of the piston into rotational motion; whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion. In order to do the conversion between two motions, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach.

It is typically connected to a flywheel to reduce the pulsation characteristic of the four-stroke cycle, and sometimes a torsional or vibrational damper at the opposite end, to reduce the torsional vibrations often caused along the length of the crankshaft by the cylinders farthest from the output end acting on the torsional elasticity of the metal.

4.10.COMPRESSOR

A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor.

Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, the main action of a pump is to pressurize and transport liquids.

CHAPTER 5

ADVANTAGES AND APPLICATIONS

ADVANTAGES

- The temperature of the engine while working will be slightly less than the ambient temperature.
- Smooth working of the engine due to very less wear and tear of the components.
- There is no possibility of knocking.
- No need of cooling systems and spark plugs or complex fuel injection systems.
- The engine runs on cold or warm air, so can be made of lower strength light weight material such as aluminium, plastic, low friction Teflon or a combination.
- Compressors use electricity for generating compressed air which is relatively much cheaper and widespread.
- Compressed-air technology reduces the cost of vehicle production by about 20%, because there is no need to build a cooling system, fuel tank, Ignition Systems or silencers.
- Low manufacture and maintenance costs as well as easy maintenance.
- Lighter vehicles cause less damage to roads, resulting in lower maintenance cost.

APPLICATIONS

- This system can be applicable for automobiles, machineries and for commercial equipment.

ENERGY CONSUMPTION OF E-VEHICLES

- This system consumes very less power than electric vehicles
- The energy consumption of electric vehicles is based on factors like its efficiency, speed, weight
- On average E vehicles consume around 15-30kWh per 100
- So for an hour of driving ,it could be roughly 15-30 kWh

ENERGY CONSUMPTION OF E-VEHICLES

- There are different types of compressor if we use a compressor with high rated kW there will be more efficiency than E vehicles
- Formula for energy consumption

  Energy consumption (kWh)=power(kW)*time(hours)
- For example if we use 5kW rated compressor and run it for 1 hour

  Energy consumption (kWh)=5(kW)*1hour=5kWh
- In this scenario if we would need 5 kWh to run the air compressor

ENERGY SUPPLY NEED TO RUN E-VEHICLE FOR 1 HOUR	**ENERGY SUPPLY NEED TO RUN COMPRESSOR FOR 1 HOUR**
• It would approximately take 15-30 kwh	• It would approximately take 5-10 kwh based on the compressor
• It takes more power than the compressor	• It takes less power than the E-vehicles

CHAPTER 6

MATERIAL SELECTION AND COST ESTIMATION

MATERIAL SELECTION

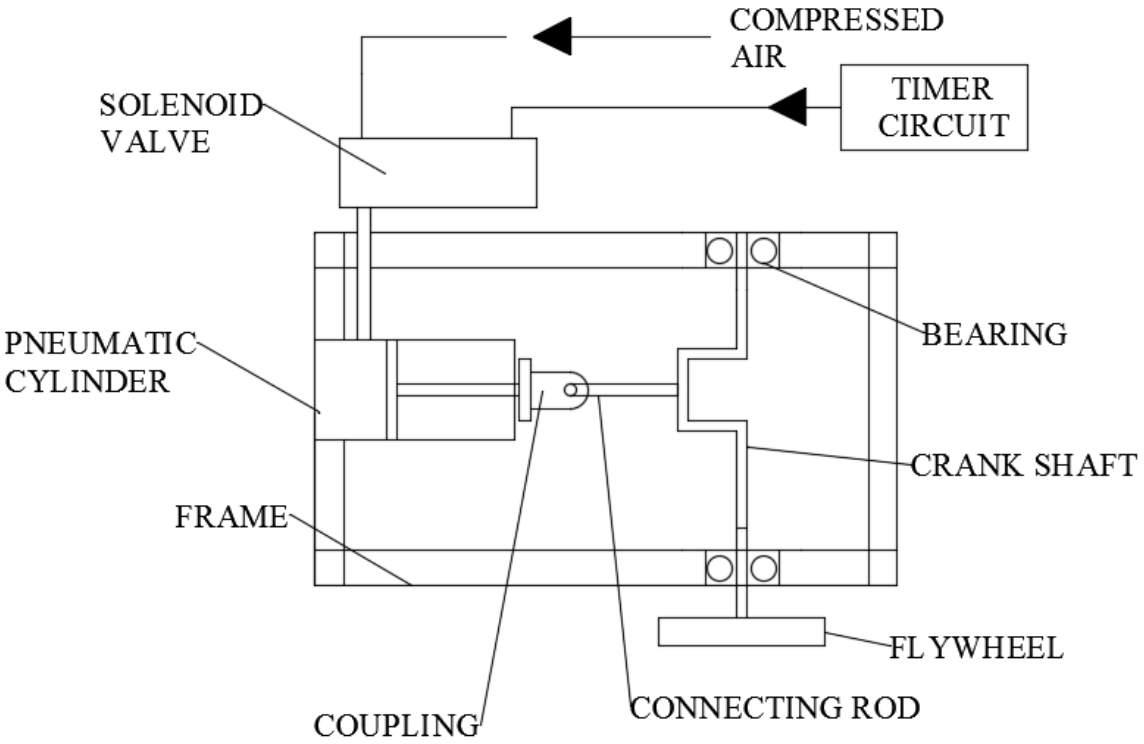
S.No	DESCIRPTION	QTY	MATERIAL
1	PNEUMATIC CYLINDER	1	ALUMINIUM
2	SOLENOID VALVE	1	PLASTIC
3	BEARING	4	STAINLESS STEEL
4	FRAME, SHAFT	AS PER REQUIREMENT	MILD STEEL
5	FLY WHEEL	1	MILD STEEL
6	METAL STRIP	AS PER REQUIREMENT	MILD STEEL
7	HOSE AND CONNECTOR	2 METRE AND 5	PLASTIC AND STAINLESS STEEL
8	CRANK SHAFT	11	STAINLESS STEEL
9	LIMIT SWITCH	1	ELECTRICAL
10	COMPRESSOR	1	MILD STEEL

COST ESTIMATION

SL.NO	DISCRIPTION	COST Rs:
1	PNEUMATIC CYLINDER	1000
2	SOLENOID VALVE	800
3	BEARING	400
4	FRAME, SHAFT	1200
5	FLY WHEEL	1500
6	METAL STRIP	200
7	HOSE AND CONNECTOR	400
8	CRANK SHAFT	800
9	LIMIT SWITCH	200
10	TOTAL	6500

CHAPTER 7

2D LAYOUTS OF MODEL



CHAPTER 8

CONCLUSION

The pneumatic-hybrid vehicle is one of the treasures to automobile industry. It promises a better combination of different power sources along-with contribution to the field of green technology. The air-hybrids are easy to manufacture and can be easily driven without any carbon footprints. So, for a better tomorrow, pneumatic-hybrid has its role. Thus, for green technology, pneumatic-hybrid is a boon. This achievement is a major break-through in battle to create greener and cheaper motoring. The result is new low cost pneumatic-hybrid which significantly cuts emission of carbon-dioxide. Existing green-hybrid cars such as Toyota Prius and Honda-Insight, use petrol engine and braking energy to generate onboard electricity to give supplementary power to the vehicle. Our vehicle uses similar principle, but instead there is no scope of entering of braking energy and can be worked in future. Thus, an efficient greener technology is guaranteed for the future with our project.

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