

Conceptualization and Implementation of Pneumatic Engine

Dr. Manan Desai ¹, Deep Gandhi ², Neel Kagathara ³, Tejas Majithia ⁴, Sunny Patel ⁵

Professor, Department of Mechanical Engineering, GCET College, Vallabh Vidyanagar, Gujarat, India¹

Student, Final Year, Department of Mechanical Engineering, GCET College, Vallabh Vidyanagar, Gujarat, India²

Student, Final Year, Department of Mechanical Engineering, GCET College, Vallabh Vidyanagar, Gujarat, India³

Student, Final Year, Department of Mechanical Engineering, GCET College, Vallabh Vidyanagar, Gujarat, India⁴

Student, Final Year, Department of Mechanical Engineering, GCET College, Vallabh Vidyanagar, Gujarat, India⁵

ABSTRACT: In today's era pollution is the major problem not only for one country but for this whole world. In this research work, we are going to make such engine which is pollution free. For that we have used compressed air technology. The aim of developing such a concept is primarily because of preventing the 3 major drawbacks of the engine being used currently- Firstly, CO and hydrocarbons are major constituents of gases emitted from conventional engine; secondly, fire hazards due to combustion of fuels; thirdly, drastically increase cost of fuels like petrol, diesel, etc due to their non renewability. Instead of these convention engines, pneumatic engine is very easy to manufacture. Here for running the engine we are going to use compressed air, which would hold some energy within it. When this compressed air expands, the energy is released to do work.

KEYWORDS: No pollution, Compressed air technology, No fire hazards, Low cost, Use of Alternative Sources of Energy.

I. INTRODUCTION

Today to buy a car or any vehicle is every one's dream and requirement also. So think for a while that if we all are emitting hazardous gases than how much global warming effect will increase? So this research is carried out by considering betterment of the whole world.

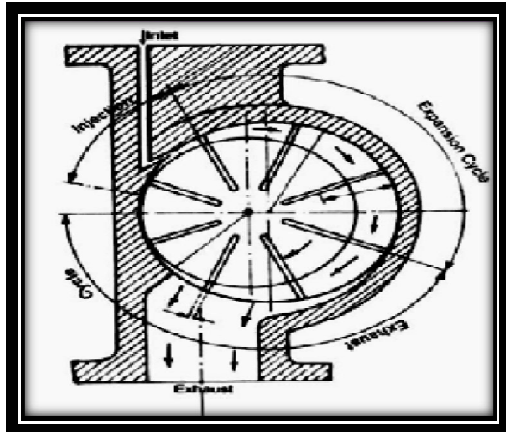
We all know that air is all around us, it will never runs out, it is non-polluting and it has no cost.

An Air powered Engine makes use of Compression of Air for its operation. Compressed Air Technology is now widely used for research by different industries. If we compress normal air then the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work i.e. to move the piston of the engine. So an Air Driven Engine is basically a pneumatic system that creates useful work by expansion of compressed air.

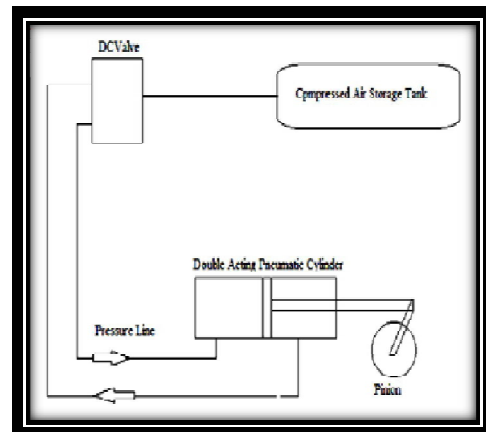
II. RELATED WORK

There has been a deep research in this field since a longtime to improvise the functionality of the air driven engine. Many scientists have given many designs for increasing usefulness of the engine. The scientists have made models like:

- 1) Compressed Air Energy Storage System Based Engine for Running Light Vehicle [1]
- 2) Vehicle Operating On Compressed Air by Inversion of Slider Crank Mechanism [1]
- 3) Air pod – The Mini Car [1]



2.1 The vane air turbine [1]



2.2 Inversion of crank slider mechanism [1]



2.3 Air Pod Car [1]

New designs or modifications can be added:

- 1) Easy starting with servo mechanism
- 2) Reuse of expansion air
- 3) Increasing pressure in the compressor without charging it again
- 4) Getting more out-put pressure by in cooperating air amplifier

III. DESIGN IN ACTION

- 1) Material can be used [found out by testing] :
For piston, connecting rod: Aluminum, Plastic, etc light weight material
Cylinder: Steel, Aluminum
- 2) Assembly of Prototype: The assembly of the prototype as shown in figure-3.2 (A) is created keeping reference of figure-3.1. The assembly shown in figure-3.1 is created in the Creo Parametric 2.0 software. There are some major changes included in the real prototype [fig.3.2 (B)] as compared to the design shown in fig.3.2 (A). These changes have been made with keeping in mind few things like the availability of the material, affordable prices, light in weight and manufacturing ease.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

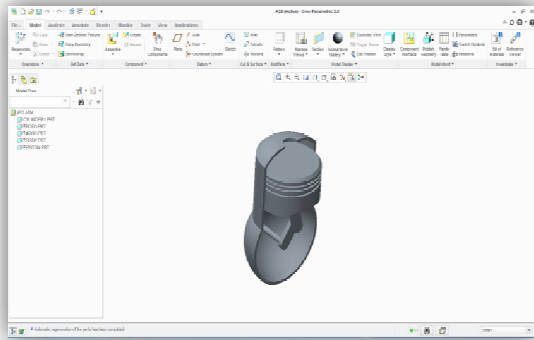


Fig. 3.1(a) 2 stroke engine

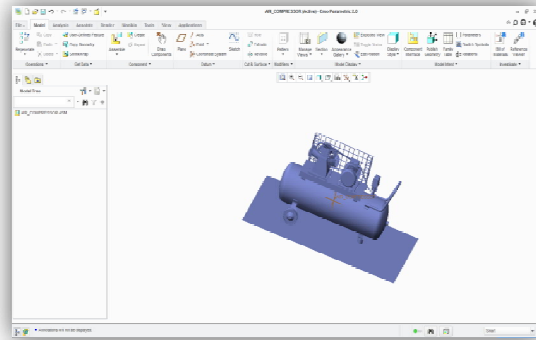


Fig. 3.1(b) Multistage Compressor

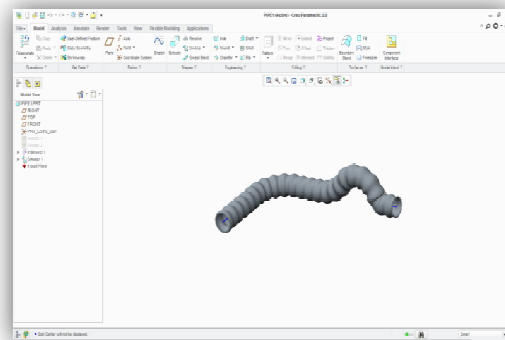


Fig. 3.1(c) Piping System

Fig.3.1 Parts of System

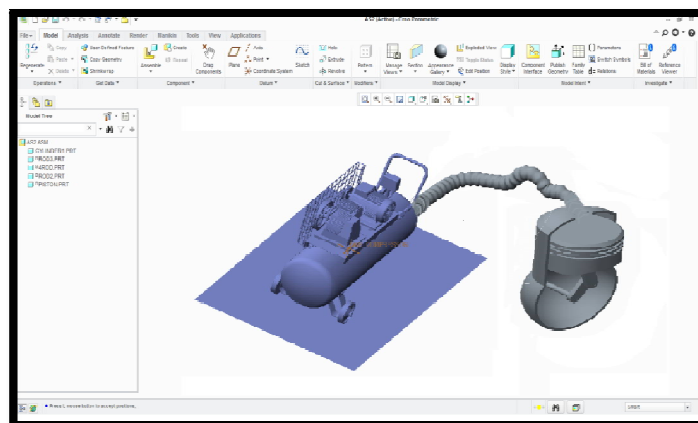


Fig.3.2 (A) Simple Assembly

- 3) **New concepts added:** These new concepts are added based on some known technology and as per our knowledge.
- a) The servo mechanism will be attached with infrared sensor. So with the help of servo mechanism we can start and stop the engine only with the help of one switch only, which can on and off by operator.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

- b) In pneumatic engine at the exhaust side compressed air get expand in the engine. This will cause its temperature down. So it is up to that extent such that it will cause cooling effect similar to fan air in our car. Hence, we can use that air for producing some amount of **cooling effect** in our automobile. [7]
- c) To use pressure control device for supplying constant pressure air to the engine. [9]
- d) We all know that air can be treated as an ideal gas. [8]

According to Ideal Gas Law, $pV = nRT$

So we can say that for constant value of V **pressure is proportional to temperature**. Hence by using heating coil in the compressed air system we can increase pressure as well as entropy of the compressed air. So we can **re-energized the compressed air** using this concept.

Here volumetric efficiency decreases but for low flow rate requirement application we can use this concept.

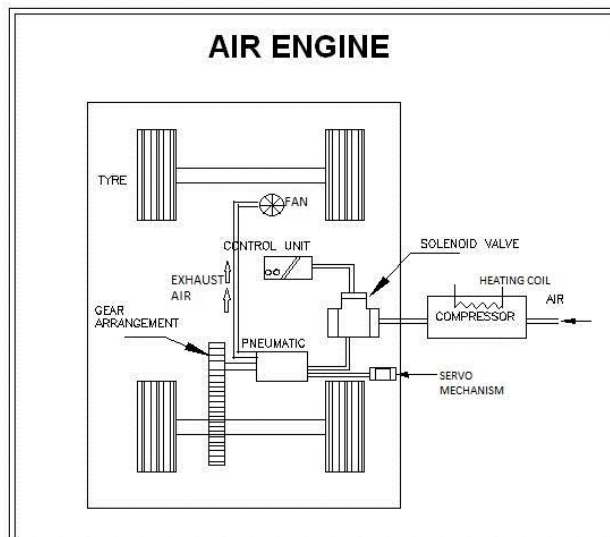


Fig.3.2 (B) The Complete Layout

In above layout, the complete assembly with addition of new concepts is shown. The servo mechanism is used to control the position of infrared sensor. As per our research, temperature of exhaust air is around 28°C to 30°C, which lies in comfort temperature zone of human being. [7] Because of that exhaust air can be thrown by fan in the automobile.

As per our testing result mentioned below if the pressure of the compressor reach below 5 kg f/cm² than that pressure is not able to overcome inertia force of the piston. In that condition we need to build up pressure once again by using 4th concept mentioned above.

IV. TESTING RESULTS

We have performed testing operation in two ways. First one by keeping pressure in the compressor constant by continuously runs the compressor and the second one by let air tank pressure continuously decreasing.

1) Constant Pressure Air supply:

Here for getting the constant pressure at particular pressure for 2 minute we keep on running compressor for same amount of time.

So, running cost of engine:

Rotation of Energy meter = 20 Rev in 2 minutes

International Journal of Innovative Research in Science, Engineering and Technology

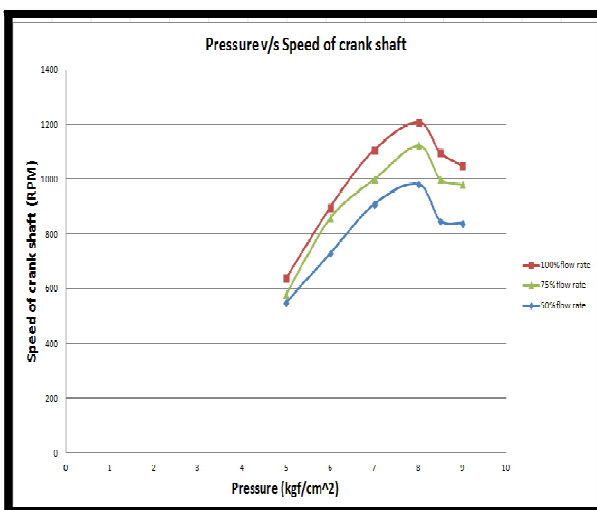
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

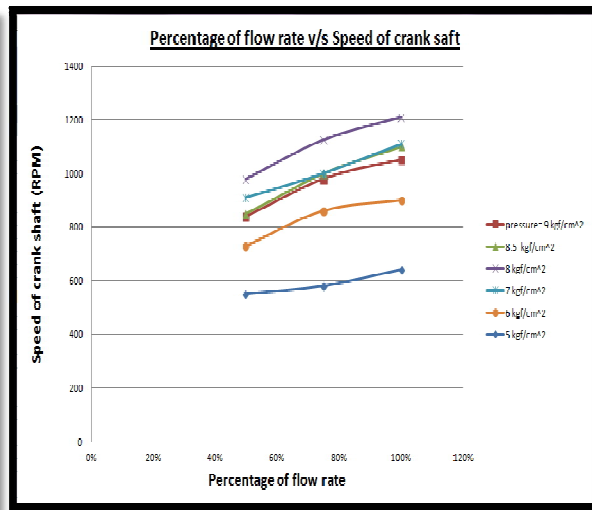
Energy meter reading = 200 Rev/ kW h
Cost of electricity per unit = 8 Rs.
Cost of Electricity = $20 \times 8 / 200$
= 80 paise

Pressure (kg f/cm ²)	Rotation of energy meter	Speed of crank shaft (RPM)		
		Percentage of flow rate		
		100%	75%	50%
9	20	1050	980	840
8.5	20	1100	1000	850
8	19	1210	1125	980
7	20	1110	1000	910
6	19	900	860	730
5	20	640	580	550

TABLE 1: PRESSURE IS CONSTANT (RESULT OBTAINED BY ACTUAL TESTING)



GRAPH: 1- PRESSURE V/S SPEED OF CRANK SHAFT



GRAPH: 2- PERCENTAGE FLOW RATE V/S SPEED OF CRANK SHAFT

2) Pressure is continuously decreasing:

Here in this case we allowed dropping down the pressure in the compressor continuously and at particular instant measured RPM of crank shaft. Those results are shown in Table 2. This is the condition without using pressure control valve.

Once compressor discharge, we need to charge compressor again. For charging compressor up to 9 kg f/ cm² cost incurred can be obtained as per following:

Energy meter reading = 200 Rev/ kW h
Cost of electricity per unit = 8 Rs.
Cost of charging air tank up to 8 bar = $94 \times 8 / 200$
= 3.76 Rs.

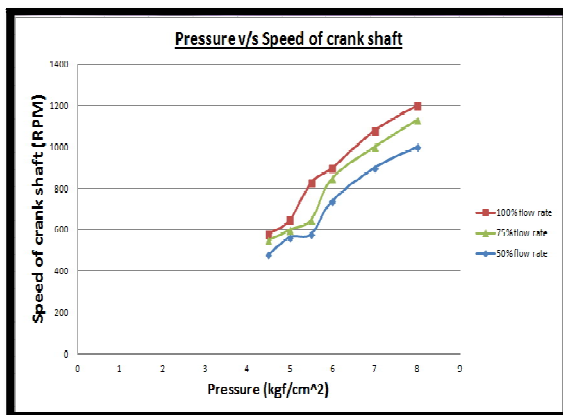
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

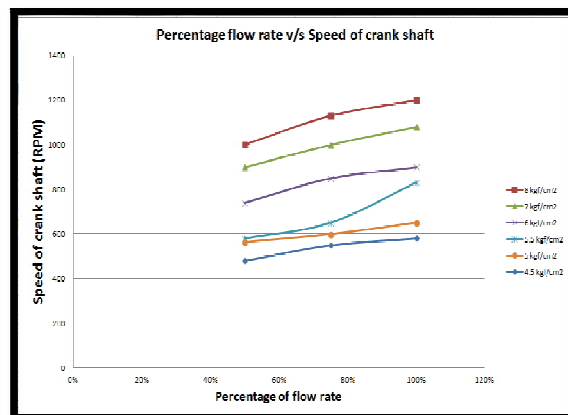
Vol. 5, Issue 6, June 2016

Pressure (kg f/cm ²)	Rotation of crank(RPM)		
	Percentage of flow rate		
	100%	75%	50%
8	1200	1130	1000
7	1080	1000	900
6	900	850	740
5.5	830	650	580
5	650	600	565
4.5	580	550	480

TABLE 2: PRESSURE IS CONTINUOUSLY DECREASING (RESULT OBTAINED BY ACTUAL TESTING)



GRAPH-3: PRESSURE V/S SPEED OF CRANK SHAFT



GRAPH-4: PERCENTAGE FLOW RATE V/S SPEED OF CRANK SHAFT

In both the case, as pressure increases speed of crank shaft increasing accordingly. As well as if flow rate increases speed of crank shaft also increases with it. These facts are shown in graph as well as in tables. Be more specific, from graph 1 we can see that up to some pressure, speed increases but after that speed decreases due to the fact that at high pressure piston cannot sustain that huge amount of thrust.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

V. COST ANALYSIS

If we want to fit pneumatic engine in our automobile then here is the total cost of air engine kit.

Sr. No.	Components	Cost (Rs/-)
1	2 stroke engine	1500
2	Engine modification	520
3	Circuit	215
4	Solenoid control Valve	2500
5	Piping System	515
6	Valve Timing Disc	60
7	Power Supply	1255
8	Air Compressor 50L Tank	15000
9	Air Amplifier	9890
	Total Cost	31455

VI. ADVANTAGES OF PNEUMATIC ENGINE

- 1) **Simple in construction.** The engine can be massively reduced in size.
- 2) **Easy to maintain and repair.**
- 3) **Low manufacture and maintenance costs.**
- 4) **No fire hazard** problem due to over loading. Air, on its own, is non-flammable.
- 5) **Quick response** is achieved.

VII. DRAWBACKS OF PNEUMATIC ENGINE

- 1) Level of lubrication requirement is higher because of absence of viscous fluid.
- 2) Very low speed of the engine compared to other conventional engine.
- 3) Theoretical efficiency of pneumatic engine is lower than traditional engine.

VIII. APPLICATION OF PNEUMATIC ENGINE

- 1) **Fluid Pumps:** Air powered Engine can also be utilized for small displacement pumps of very low pressure capacities.
- 2) **Power Generator:** It can store energy as compressed air in one cylinder and it can be used as a generator in absence of electricity. It can also used as a mobile power producing device in small villages where electricity is not available.
- 3) **Conveyor Drive:** Air powered engines can be used as drives for different types of conveyors such as Chain conveyors, Belt conveyors, etc.
- 4) **Automobiles:** The use of the Air powered Engine is possible for automobiles as 2 wheelers and light motor vehicles.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

IX. CONCLUSION

We were able to successfully complete the design and fabrication of the Air Driven Engine. By addition of servo mechanism starting and stopping of the engine can be easily achievable. It can be easily automated because only power given to the system is 24 V power supply. The main problems in this world are pollution and increasing cost of fuels can be very efficiently solved by the adoption of this method. Also, very fewer efforts are needed to be applied for its working on the real-situation fields.

The Air Driven Engine provides an effective method for power production and transmission. Even though its applications are limited currently, further research could provide wider applications.

REFERENCES

- [1] Saurabh Pathak, Kontham Swetha, V.Sreedhar and V.S.V Prabhakar, Compressed air vehicle: a review, International journal of mechanical and production engineering, ISSN: 2320-2092, Volume- 2, Issue- 4, Page no.10-12, April-2014.
- [2] S. S. Verma, Latest developments of a compressed air vehicle: a status report, Global journal of researches in engineering automotive engineering, ISSN: 2249-4596, Volume 13, Issue 1, Version 1.0, Page no. 15-23, Year 2013.
- [3] Air powered engine (2011) by Prof. B. S. Patel, Mr. R. S. Barot, Karan Shah, Pushpendra Sharma
- [4] Study and fabrication of compressed air engine(2011) by Bharat Raj Singh and J. P. Yadav (2011)
- [5] Mistry Manish K., Dr. Pravin P. Rathod, Prof. Sorathiya Arvind S., Study and development of compressed air engine single cylinder: a review study, International journal of advanced engineering technology, Vol.III, Issue I, Page no. 271-274, January-March, 2012.
- [6] Popular mechanics: <http://www.popularmechanics.com> Harley, M.; Ford, G.M. considering joint engine development
- [7] Refrigeration and air conditioning by Prof. M. Ramgopal, Indian institute of technology, Kharagpur department of mechanical engineering lecture no. # 36 inside design conditions thermal comfort.
- [8] The ideal gas law gas constant applications of the gas law.
- [9] Controllers and Controlled systems – SAMSON.