ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Impact Factor: 8.206

Volume 8, Issue 6, June 2025

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Design and Development of Air Compressed Pneumatic Engine

Niranjan Vikas Jasud, Pramod Ananda Babar, Suraj Chandrakant Jadar, Avadhut Kiran Kadam, Prof.S.S. Kothale

Department of Mechanical Engineering, Sharad Institute of Polytechnic, Yadrav, Maharastra, India

ABSTRACT: This project presents the design and implementation of a pneumatic engine, highlighting its potential as an eco-friendly and efficient alternative to traditional mechanical systems. The engine employs a pneumatic cylinder with a 75mmstroke length and a16mm bore to generate linear motion, which is subsequently converted into rotary motion using a crankshaft mechanism. A 300mm diameter metal disc is affixed to the crankshaft output to facilitate rotational balance and visual representation of motion.

Control of the pneumatic system is achieved through a 5x2 solenoid directional control valve actuated by an Arduino Nano microcontroller and a single-channel relay board. This integration ensures precise regulation of compressed air flow, enabling efficient operation of the system. The entireassemblyismountedonafabricatedstructureconstructedfrom20mmsquarepipes, providing a sturdy and durable framework.

The project showcases the synergy between pneumatic, mechanical, and electronic systems, demonstrating the feasibility of compressed air as a sustainable energy source. The developed pneumatic engine not only serves as a proof of concept but also emphasizes the importance of innovative and environmentally conscious engineering solutions.

I. INTRODUCTION

1.1 What is Smart Manufacturing?

Pneumatic engines are innovative systems that utilize compressed air to generate mechanical motion, provid in environmentally friendly and energy- efficient alternative to traditional combustion engines. This project focuses on the design and development of a pneumatic engine that demonstrates the principles of pneumatics and mechanical energy conversion.

The core component of the engine isa pneumatic cylinder with a 75mm stroke length and a 16mm bore. A metal disc with a diameter of 300mm is attached to the crankshaft's output, serving as a visual indicator of the rotary motion and aiding in balancing the rotational inertia.

The motion control of the pneumatic cylinder is achieved using a 5x2 solenoid directional control valve ,which is operated by an Arduino Nano microcontroller. The Arduino Nano, in conjunction with a single- channel relay board, ensuring smooth and efficient operation of the engine.

The entire setup is mounted on a robust fabricated structure made of 20mmsquare pipe, providing the necessary stability and durability to support the components during operation. This project not only highlights the practical application of pneumatic systems but also showcases the integration of mechanical and electronic systems to create an efficient and functional machine.

II. THEORY

Research and Methodology

Research

The development of this pneumatic engine project began with extensive research into pneumatic systems and their applications .The study included an analysis of:

- The principles of pneumatic actuation and energy conversion.
- The design and operation of pneumatic cylinders, directional control valves, and crank shaft mechanisms.
- Existing prototypes and industrial applications of pneumatic engines to identify potential improvements and innovations.

Additional research was conducted on the integration of microcontrollers and electronic control systems, focusing on the Arduino Nano and its compatibility with relay modules and solenoid valves. The fabrication process was also reviewed, including the selection of materials and structural design for durability and efficiency.

III. METHODOLOGY

1. **Design and Planning**:
   - Created detailed schematics and CAD models for the pneumatic engine components and overall structure.
   - Selected key components, including a 75mm stroke length,16mmborepneumatic cylinder, 5x2solenoid directional control valve, and a 300mm diameter metal disc.

2. **Component Procurement**:
   - Sourced high-quality materials and components, ensuring compatibility and reliability.

3. **Fabrication and Assembly**:
   - Constructed a robust framework using 20mm square pipes to support the engine components.
   - Assembled the pneumatic cylinder, crankshaft mechanism, and metal disc.

4. **Control System Development**:
   - Programmed the Arduino Nanoto control the solenoid valve via a single-channel relay board.
   - Implemented a logic-based control system for precise actuation of the cylinder and efficient operation.

5. **TestingandOptimization**:
   - Conducted initial tests to evaluate the functionality and performance of the pneumatic engine.
   - Adjusted system parameters, including air pressure and control timings, to optimize efficiency and smooth operation.

6. **Documentation and Analysis**:
   - Documented the design ,assembly process ,and test results.
   - Analyzed the engine's performance and identified potential areas for future improvement.

This structured approach ensured the successful development of a functional pneumatic engine prototype while promoting an understanding of the synergy between mechanical, pneumatic, and electronic systems.

- **Circuit Diagram**

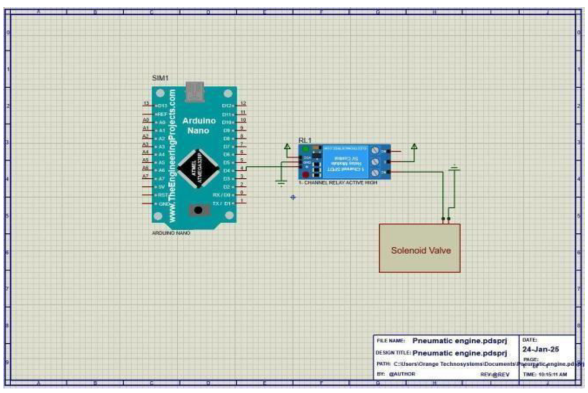

Fig (1)-Circuit Diagram of Pneumatic Engine

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806245

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

- **Operating Principle:**

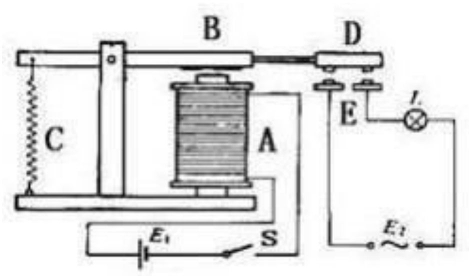

Fig (2)–Electromagnetic Relay

- **Solenoid Valve:**

Fig (3)-Solenoid Valve

- **Specification**

Specification

Model Information	
Model No	SFA1
Type	5X2
Design	Spool with Cartridge Type
Port Size	In/Out - 1/4" BSP & Exhaust - 1/8" BSP
Media	Compressed Air, Filtered & Lubricated
Working Pressure Range	2 - 10 bar
Ambient/Medium Temperature	5°- 60° C
Flow	1200 lpm
Materials of Construction	Aluminium, Nitrile, Brass, Polymer

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

IV. MACHINING PROCESSES USED

- **Steps in the Turning Process:**

1. **Preparation:**
2. **Setting Up the Lathe**:
3. **Turning Operation**:
4. **Taper Turning**
5. **Material Removal:**
6. **Finishing:**

Inspection:
Measure the workpiece dimensions using calipers or micrometers.
Verify tolerances and surface finish as per the design specifications.

- **Applications of Lathe Turning:**

Creating cylindrical, conical ,and threaded components.
Producing shafts, bolts, bushings, and pulleys.

- **PHOTOGRAPHS**

Fig (4)–Model Equipment's

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. LITERATURE SURVEY

1. **AnirudhAddala**et.al.[1]examines the performance of a car which takes air as the working medium. Air car is a car currently being developed which is still in the R&D stage all over the world. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air car move.

2. **A. A. Keste** et. al. [2] describes the working of a vehicle which works on pneumatic power. In this system a double acting pneumatic cylinder is operated as a slider crank mechanism which converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft.

3. **S. S. Verma S.L.I.E.T**., Longowal et. Al.[3] introduce to the latest developments of a compressed-air vehicle along with an introduction to various problems associated with the technology and their solution. Compressed air as a source of energy in different uses in general and as a nonpolluting fuel in compressed air vehicles has attracted scientists and engineers for centuries.

4. **Pramod Kumar:** studied In this project, an SI engine is converted into a compressed air engine .A four stroke single cylinder SI engine is converted to two stroke engine which operates using compressed air because of its design simplicity. As we converted the already existing conventional engine into an air powered one, this new technology is easy to adapt. Another benefit is that it use air as fuel which is available abundantly in atmosphere.

5. **D.Ravi**et.al.[8] analyzed the Climate change and energy security require a reduction in travel demand, a model shift and technological innovation in the transport sector. . Through a series of press releases and demonstrations, a car using energy stored in compressed air produced by a compressor as been suggested as an environmental friendly vehicle of the future.

6. **S.S. Verma**et.al.[7] briefly summarize the principle of technology, latest developments, advantages and problems in using compressed air as a source of energy to run vehicles. Compressed air for vehicle propulsion is already being explored and now air powered vehicles are being developed as a more fuel-efficient means of transportation.

VI. CONCLUSION

The pneumatic engine developed in this project successfully demonstrates the practical application of compressed air as a clean and efficient energy source. By integrating pneumatic, mechanical, and electronic systems, the engine converts linear motion into rotary motion with precision and reliability.Theuseofa75mm stroke pneumatic cylinder, a 5x2 solenoid directional control valve, and an Arduino Nano-based control system ensures smooth and efficient operation.

The robust fabricated structure provides the necessary stability and durability, making the system suitable for diverse applications. The advantages of the pneumatic engine, including eco- friendliness, cost- effectiveness, safety, and simplicity, highlight its potential as a sustainable alternative to conventional combustion engines.

This project not only serves as a proof of concept but also paves the way for further advancements in pneumatic technology. With continued research and development, The success of this project underscores the importance of innovation and the synergy of multidisciplinary engineering in solving real-world challenges.

REFERENCES

1. Pneumatic Systems and Components Basics and
2. Applications. Available at : https://www.pneumatics.co m
3. Arduino Nano Documentation and Technical Reference. Available at: https://www.arduino.cc.
4. Principles of Pneumatic Actuation and Paper by Smith ,J.& Taylor, M., 2020.
5. Design and Analysis of Crankshaft Mechanisms - Journal of Mechanical Engineering,Volume45,Issue3,2018.
6. Fabrication Techniques for Small-Scale Prototypes – Workshop Manual, Industrial Training Institute, 2019.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

7. Sustainable Engineering Practices: The Role of Pneumatics - International Conference on Green Technologies, Proceedings, 2021.
8. Solenoid Valves: Design and Application - Technical Manual by Valve Tech Industries.
9. Safety and Efficiency in Pneumatic Systems - Article by Mechanical Engineering World, 2020.
10. These references provided the foundational knowledge and technical guidance necessary for the successful completion of the pneumatic engine project.

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com