Air Compressed Engine

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Abstract - *This paper explores the potential of pneumatic actuators utilizing compressed air to transform energy, presenting an innovative approach to eco-conscious propulsion. The Air Driven Engine emerges as a sustainable alternative, operating solely on compressed air expansion to propel engine pistons. By harnessing Compressed Air Technology, this engine bypasses the need for fuel-air combustion, offering a clean energy solution. Compressing ambient air within a cylinder stores inherent energy, which upon release drives pistons to perform mechanical work. This process underscores the simplicity and efficiency of Compressed Air Technology, providing a versatile platform for various applications.*

Moreover, the integration of compressed air propulsion into hybrid systems, such as battery electric propulsion and fuel tanks, introduces Hybrid-Pneumatic Electric Propulsion. This hybridization optimizes energy utilization, enhancing overall efficiency while reducing reliance on conventional fuels. Furthermore, the synergy with regenerative braking enhances energy recovery, minimizing waste and bolstering sustainability efforts. As such, the combination of compressed air technology and hybrid propulsion holds immense potential for revolutionizing transportation paradigms, offering a pathway towards cleaner, more efficient mobility solutions.

***Key Words*: Air Compressed Engine, Air Compressor, Solar Panel, Pneumatic Piston, Pressure Regulator**

1. INTRODUCTION

A compressed gas engine is a pneumatic gadget that generates useful motion by expanding compressed air. A squeezed-air vehicle is powered by an air engine, utilizing compressed air, which is kept in a container. Rather than blending fuel with air and burning it in the engine to drive pistons with hot expanding gases, squeezed air vehicles (CAV) utilize the expansion of compressed air to drive their pistons. They have appeared in many shapes over the past two centuries, extending in size from hand held turbines up to several hundred horsepower. For instance, the first mechanically-operated submarine, the 1863 Plongeur, utilized a squeezed air engine.

The laws of physics dictate that uncontained gases will fill any given space. The simplest way to witness this in action is to blow up a balloon. The elastic skin of the balloon holds the air firmly inside, but the moment you use a pin to create a hole in the balloon's surface, the air expands outward with so much energy that the balloon bursts. Squeezing a gas into a small space is a way to stash energy. When the gas expands again, that energy is released to do work. That's the fundamental principle behind what makes an air freighter. Some types rely on pistons and cylinders, others use whirligigs. Many compressed air engines enhance their performance by warming the incoming air, or the engine itself. Some took this a stage further and ignited fuel in the cylinder or whirligig, forming a type of inner combustion engine.

One manufacturer claims to have devised an engine that is 90 percent efficient. Compressed air propulsion may also be integrated in mixed systems, e.g., battery electric propulsion and fuel tanks to refill the batteries. This sort of system is termed hybrid-pneumatic electric propulsion.

2. WORKING PRINCIPLE

The working of this project "Air Compressed Engine" is based on the principle of conversion of potential energy stored in compressed air into mechanical energy through controlled expansion. In the initial stage of air compression, ambient air undergoes compression using a battery-powered compressor, with the battery being recharged by a solar panel, tapping into solar energy. The compressed air is then stored in an air tank or reservoir. Moving on to the air admission stage, the compressed air is drawn from the air tank into a pneumatic cylinder through an inlet valve. This pneumatic cylinder is linked to a chain drive, further connected to the wheel. During the power stroke, as the compressed air enters the cylinder via port A, the piston extends outward, generating force. This force is then transmitted through the chain drive, inducing rotation of the wheel. Subsequently, in the exhaust stroke phase, following the power stroke, the compressed air enters port B of the cylinder, prompting the piston to revert to its initial position, expelling the expanded air via an exhaust valve. This continuous cycle of air admission, power stroke, and exhaust stroke ensues repetitively, ensuring uninterrupted rotation of the wheel.

Components of Air Compressed Engine: Air Compressor, Air Storage Tank, Battery, Solar Panel, Pneumatic Piston, Pneumatic Valve, Pressure Regulator, Pressure Control Unit, Hoses, Wires, Wheels.

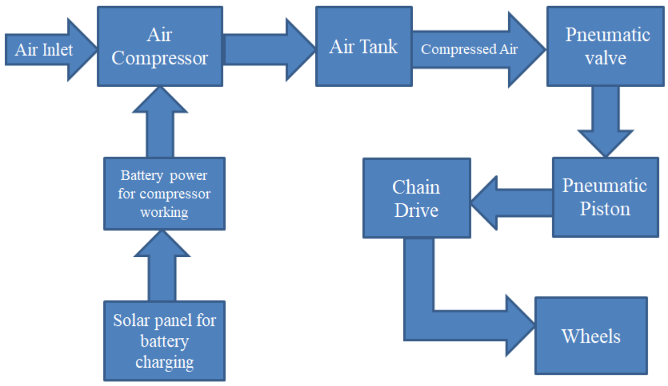

Fig-1: Flow Chart of Air Compressed Engine

3. AIR COMPRESSOR

The air compressor is like the heart of an air-powered engine system. It pulls in air from the surroundings and squeezes it tightly before sending it to a storage tank. This squeezed air is then used to power different parts of the engine. The air compressor does a few important jobs:

1. Squeezing air
2. Storing air
3. Making power
4. Managing airflow

Fig-2: Air Compressor

4. AIR STORAGE TANK

An air reservoir plays a vital role in an air-compressed propulsion system. In this setup, pressurized air is contained within the reservoir. When power is required, the stored air is released to propel pistons or turbines, converting it into mechanical energy.

The air reservoir fulfills various crucial functions: Storage, Pressure Management, Energy Backup, Security, and Effectiveness.

Fig-3: Air Storage Tank

5. BATTERY

In the realm of a compressed air engine, batteries commonly function as an additional power reserve to aid different electrical components within the arrangement. These batteries resemble those employed in traditional vehicles or other electrically driven gadgets, yet their distinct structure and capability hinge on the needs of the compressed air engine configuration.

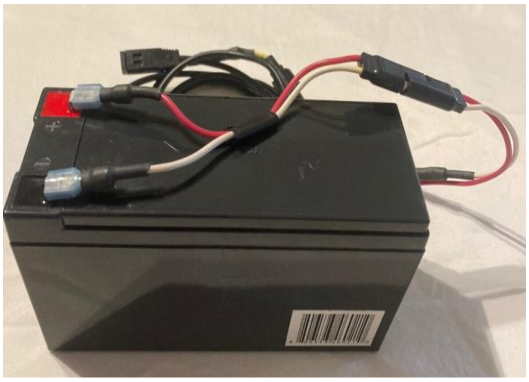

Fig-4: Battery

6. SOLAR PANEL

Solar panels are gadgets that transform sunlight into electricity through the photovoltaic phenomenon, a mechanism that creates an electric current when specific substances are illuminated. Harnessing solar energy, the panels charge the battery during daylight hours, ensuring a steady power supply for the air compressor even when sunlight is scarce. This sustainable energy cycle minimizes reliance on traditional power sources and reduces environmental impact.

Fig-5: Solar Panel

7. PNEUMATIC PISTON

The pneumatic cylinder in a compressed air engine is a crucial element responsible for transforming the stored potential energy in compressed air into mechanical output.

Fig-6: Pneumatic Piston

8. CALCULATION

During design and fabrication of our project "Air Compressed Engine", we have done following calculations to find torque:For a compressed air engine, the force is provided by the expansion of the compressed air, which can be estimated from the air pressure and cylinder dimensions.

Given:

Cylinder bore diameter = 25 mm = 0.025 m

Maximum operating pressure = 10 bar = 1000 kPa

Cylinder length = 0.1 m (a typical value for small pneumatic cylinders)

Cross-sectional area of the cylinder:

Area = π × r^2 = π × (0.025/2)^2 = 1.96 × 10^-3 m^2

Force at maximum operating pressure:

Force = Pressure × Area

= 206 kPa × 1.96 × 10^-3 m^2

= 0.403 kN

Torque calculation:

Torque = Force × Radius

Radius = Cylinder length / 2 = 0.1 / 2 = 0.05 m

Torque = Force × Radius

= 1.96 kN × 0.05 m

= 0.098 kN·m = 98 N·m

Therefore, the torque produced by the compressed air engine with the given specifications is approximately 98 N·m.

9. CONCLUSION

The prototype devised by our team is a miniature version of the compressed air engine. When expanded to larger scales, it holds potential for driving vehicles independently or in conjunction with other engines like internal combustion engines.

Key benefits of the Compressed Air Engine (C.A.E.) include:

1. Emission neutrality

2. Utilization of sustainable resources.

3. Elimination of fuel expenses (with costs only attributed to air compression).

It's worth noting that while the idea of vehicles solely powered by compressed air may seem futuristic, they continue to pique public interest due to their eco-friendly attributes. Research into compressed air propulsion for vehicles is ongoing, with air-powered vehicles emerging as a promising avenue for more efficient transportation solutions. Pneumatic vehicles are anticipated to supplant battery-operated counterparts in industrial settings, boasting quicker refueling times compared to electric alternatives.

9. ADVANTAGES

1. Avoiding the necessity for fuel transportation by accessing electricity from the grid yields substantial economic advantages.
2. Eliminating the pollution generated during the transportation of fuel.
3. Adoption of compressed air technology decreases vehicle manufacturing expenses by approximately 20% as it

obviates the need for constructing cooling systems, fuel tanks, ignition systems, or silencers.
4. Air, as a standalone entity, lacks flammability.

10. LIMITATIONS

1. Tanks get very hot when filled rapidly. SCUBA tanks are sometimes immersed in water to cool them down when they are being filled. That would not be possible with tanks in a car and thus it would either take a longtime to fill the tanks, or they would have to take less than a full charge, sinceheat drives up the pressure.

2. Early tests have demonstrated the limited storage capacity of the tanks; the only published test of a vehicle running on compressed air alone was limitedto a range of 7.22 km.

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PHOTOGRAPHY

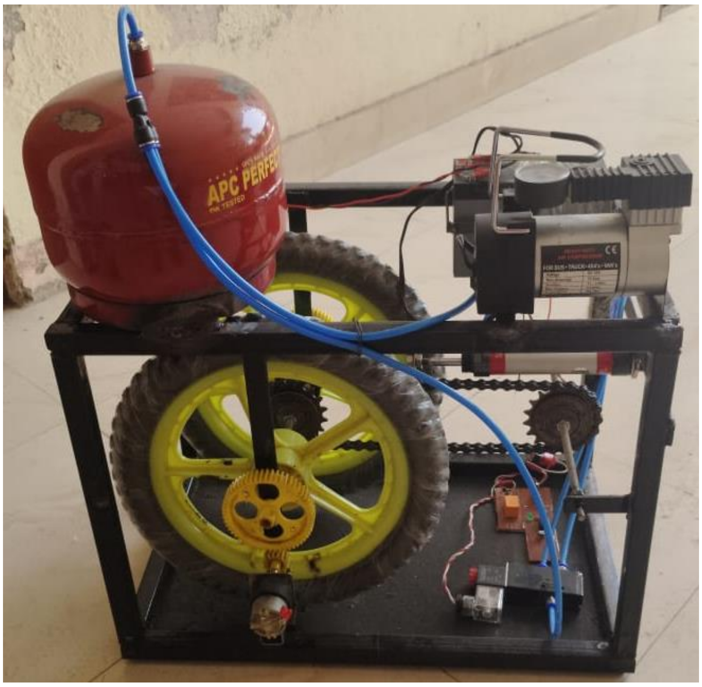

Fig-7: Air Compressed Engine

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