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Fabrication of Pneumatic Vehicle By Using Inversion of Slider Crank Mechanism

Ranjithkumar A¹, Sankar S², Sridar S.S³, J.Prabakaran⁴

U.G. Student, Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram, Tamilnadu
India,^{1,2&3}

Assistant Professor, Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram,
Tamilnadu, India,⁴

ABSTRACT: Gasoline, which has been the main source of fuel for the history of cars, is becoming more and more expensive and impractical (especially from an environmental standpoint). But cost is not only the problem with using gasoline as our primary fuel. It is also affecting the environment, and since it is not a renewable resource, it will eventually run out. One of the possible alternatives is the air-powered vehicle. One among them is the compressed air vehicle, which does not require any of the known fuels like petrol, diesel, CNG, LPG, hydrogen etc., this works on compressed air. This replaces all types of till date known fuels and also permanently solves the problem of pollution, since its clean and cool air.

In this project, compressed air vehicle is powered by an double acting cylinder using compressed air, they compressed air stored in the storage cylinder will actuates the piston. Therefore they pressure energy is converted in to the rotary power. This rotary motion will be given to the vehicle for the motion.

The renewable energy (i.e. compressed air) used as source for vehicle motion is one of the latest technology in inversion of slider crank mechanism. The development, advantages and application of this vehicle is being explained in this project.

KEYWORDS: Compressed Air Energy, Directional Control Valve, Pneumatic Power, Inversion of Slider Crank Mechanism.

I. INTRODUCTION

In a pneumatic system, the working fluid is a gas (mostly air) which is compressed above atmospheric pressure to impart pressure energy to the molecules. This stored pressure potential is converted to a suitable mechanical work in an appropriate controlled sequence using control valves and actuators. Conversion of various combinations of motions like rotary-rotary, linear-rotary and linear-linear is possible. The simplicity in design, durability and compact size of pneumatic systems make them well suited for mobile applications. Pneumatic control system plays very important role in industrial system owing to the advantages of low cost, easy maintenance, cleanliness, readily available, and cheap source, etc.,. A particularly well suited application for vehicle operating on compressed air is material handling and for visitors in industry.

Compressed air storage energy (CASE) is a promising method of energy storage, with high efficiency and environmental friendliness. Compressed air is regarded as fourth utility, after electricity, natural gas, water and the facilitating production activities in industrial environment. Unfortunately production of compressed air solely for pneumatic vehicle is not affordable but in manufacturing industries compressed air is widely used for many applications such as cooling, drying, actuating and removing metal chips. In addition, as a form of energy, compressed air represents no fire or explosion hazards; as the most natural substances, it is clean and safe and regarded as totally green. The performance of air car is explain in which the importance of the impact of the fossil fuels in the present and future generations is explained which led them to design a new vehicle which runs by renewable energy sources. Compressed air vehicle are more suitable for low speed, short range and flammable environment.

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1.2 MAJOR COMPONENTS OF FOUR WHEELER VEHICLE

The major components of four wheeler vehicle include:

- a) Frame
- b) Steering system
- c) Tire
- d) Transmission system
- e) Compressed Air Storage Tank
- f) springs
- g) Clutch and throttle
- h) Engines

(a) Frame

The vehicle frame is often of steel, aluminium or an alloy. The frame consists mostly of hollow tubes with combination of sheets. This serves as a skeleton on which components like the gear box and engine are mounted. The wheels are generally aluminium or steel rims with spokes, although some cast wheels are used. Graphite and magnesium parts are increasingly in use because of high strength-to-weight characteristics.

(b) Steering System

Steering is the term applied to the collection of components, linkages, etc. which will allow a vehicle (car, motor cycle and bicycle) to follow the desired direction. The most conventional steering arrangement is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints (which may also be part of the collapsible steering column design), to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear-wheel steering. Tracked vehicles such as bulldozers and tanks usually employ differential steering that is, the tracks are made to move at different speeds or even in opposite directions, using clutches and brakes, to bring about a change of course or direction.

(c) Tires

A tire (or tyre) is a ring-shaped covering that fits around a wheel's rim to protect it and enable better vehicle performance. Most tires, such as those for automobiles and bicycles, provide traction between the vehicle and the road while providing a flexible cushion that absorbs shock.



Fig 1 Tire

The materials of modern pneumatic tires are synthetic rubber, natural rubber, fabric and wire, along with carbon black and other chemical compounds. They consist of a tread and a body. The tread provides traction while the body provides containment for a quantity of compressed air. Before rubber was developed, the first versions of tires were simply bands of metal that fitted around wooden wheels to prevent wear and tear. Early rubber tires were solid. Today, the majority of tires is pneumatic inflatable structures, comprise a doughnut-shaped body of cords and wires encased in rubber and generally filled with compressed air to form an inflatable cushion. Metal tires are still used on locomotives and railcars, and solid rubber (or other polymer) tires are still used in various non-automotive applications such as some casters, carts, lawnmowers and wheel barrows.

(d) Transmission System

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The transmission system is the system of transmitting the power from the engine to the vehicle wheel for initiating the motion. The transmission system also includes gearbox, which is used to increase the power. Transmissions vehicle typically have four to six speeds, although small bikes may have as few as two. Power is normally transmitted to the rear-wheel sprockets by a chain, though occasionally belts or shafts are used. In this project sprocket and chain drive transmission system is used for the transmission of power to the rear wheels.



Fig 2 Transmission System

(e) Compressed Air Storage Tank

The compressed air storage tank is a tank which is capable of storing compressed air at a very high pressure which is compressed by the compressor. In order to compress the air at a very high pressure a high pressure compressor has to be used.



Fig 3 Compressed Air Storage Tank

Usually the compressed air storage tank is made of materials like carbon fiber, kevlar, mild steel, stainless steel, cast iron, etc. according to purpose. The compressed air storage tank consists pressure inlet valve, outlet valve, relief valve, drain valve, pressure gauge etc.

II.INVERSION OF SLIDER CRANK MECHANISM

The slider crank mechanism as shown in Fig.1 has a four links connected by three revolute joints and one prismatic joint of lower pair or surface contact. In this inversion the cylinder is fixed and piston inside reciprocates and this reciprocating motion is converted in to the rotary motion of crank

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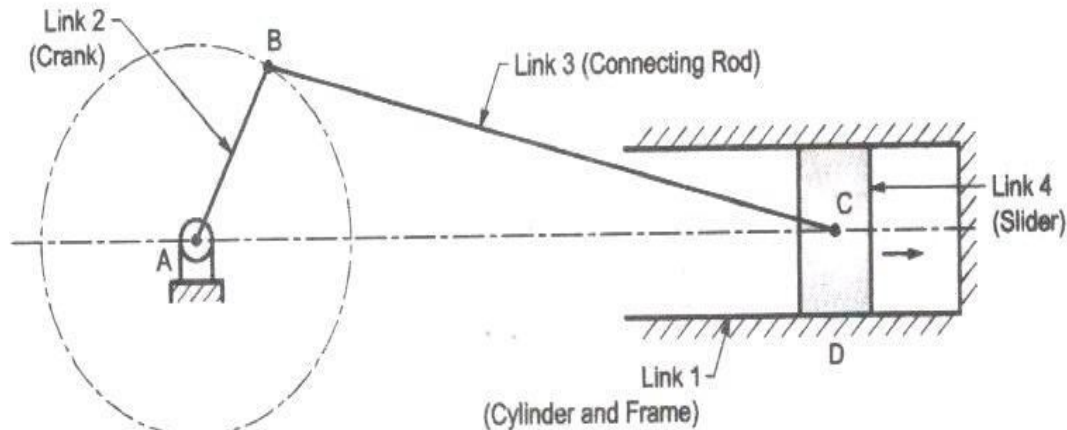


Fig 4 Inversion of slider crank mechanism

In this system a double acting pneumatic cylinder operated as a slider crank mechanism that converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft. The pinion shaft further drives the pinion, which will turn the gear wheel on the output shaft. The output shaft carries the system that converts the oscillatory motion of the gear into the single direction rotation of the chain vehicle by means of a unidirectional clutch arrangement.

The pneumatic linear actuator as shown in Fig.5 supplies compressed air by means of an appropriate filter-regulator-lubricator (FRL) unit and a 5/2 foot operated pneumatic direction control valve. This system is capable of being driven to given intermittent as well as continuous motion to the chain vehicle system. The system uses pneumatic cylinder, which is fast actuation system, hence the vehicle has fast response. The system incorporates a provision to arrest the stroke of the actuator to a desired level there by deciding the length of travel of the vehicle thus making the system flexible enough to serve the needs of the flexible production system.

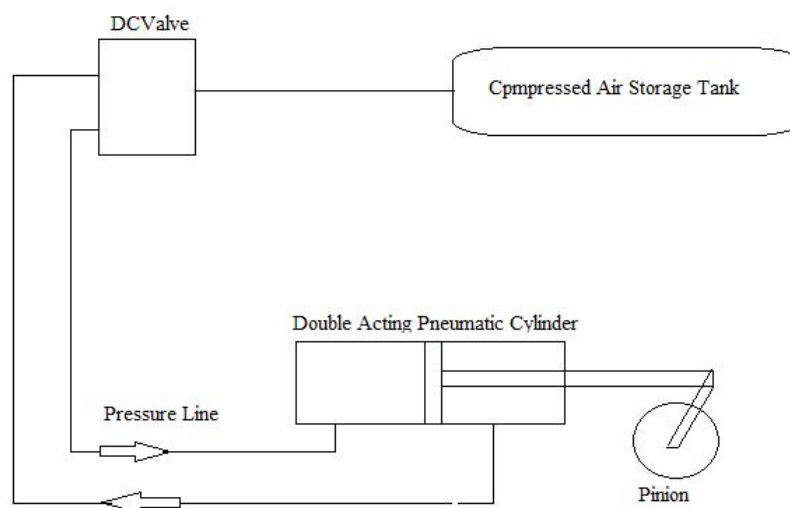


Fig.5 Assembly layout

III.WORKING OF COMPRESSED AIR POWERED VEHICLE

The working of the compressed air powered vehicle is similar to the conventional vehicle the only change in the engine. In conventional vehicle double acting cylinder used where as in compressed air powered vehicle double

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acting cylinder is used. Also in conventional vehicle there will be the fuel tank where as in compressed air powered vehicle air storage tank is used. The working of the compressed air powered vehicle is given below. Double acting cylinder converts the pressure energy of air into the mechanical energy. This mechanical energy will be in the form of rotary motion. This rotary motion is transferred to the rear wheel by the sprocket and chain drive system. The speed control of the driver will be done by using pneumatic regulator. Whenever the driver wants to rise or slow the vehicle he can adjust the regulator unit.

IV. WORKING OF DOUBLE ACTING CYLINDER

Pneumatic cylinders or air cylinders are mechanical devices which use the power of compressed air to produce a force in a reciprocating linear motion or cylinders which convert pneumatic power into mechanical power. Compressed air forces the piston to move in the desired direction. As the operating fluid is air, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

Because air is an expandable substance, it is dangerous to use a pneumatic cylinder at high pressure so they are limited to 8 bar (gauge) pressure. Consequently they are constructed from lighter material such as aluminium and brass. Because gas is a compressible substance, the motion of a pneumatic cylinder is hard to control precisely. The force exerted by the compressed air moves the piston in two directions in a double acting cylinder. These are used particularly when the piston is required to perform the work not only in the forward movement but also on the return. In principle, the stroke length is unlimited, although buckling and bending must be considered before we select a particular size of piston diameter, rod length and stroke length.

V. WORKING OF 5/2 DC VALVE

A pneumatic cylinder is hard to control precisely. The force exerted by the compressed air moves the piston in two directions in a double acting cylinder. These are used particularly when the piston is required to perform the work not only in the forward movement but also on the return. In principle, the stroke length is unlimited, although buckling and bending must be considered before we select a particular size of piston diameter, rod length and stroke length. Second position - In the second position as shown in Fig.4 the pressurized air is supplied to the piston rod end through port P, B causing the piston to retract. During the retraction the air present at the piston side is forced out through port Q.

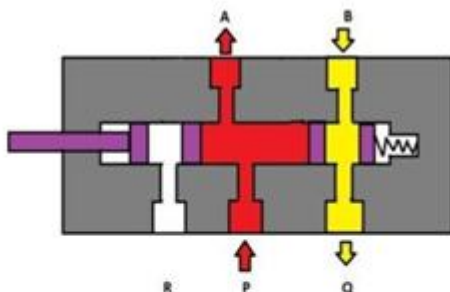


Fig 6, 5/2 Valve in First Position

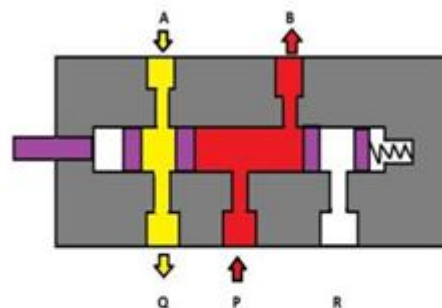


Fig 7, 5/2 Valve in Second Position

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VI.PROTOTYPE PARAMETERS

Fig. 8 shows prototype of pneumatic vehicle develops in the college workshop. shows the dimensions of the prototype.



Fig 8 Prototype pneumatic vehicle

Dimension of Prototype Vehicle

Length : 1500mm
Width : 900mm
Height : 150mm
Load : 100kg

Specification of Double Acting Cylinder

Model	SC
Structure	Piston Cylinder
Power	Pneumatic
Body Material	Aluminum
Bore Diameter	50mm
Stroke length	150mm
Rod Diameter	25mm
Working Pressure	1.5-8 Bar

Specification of Air Storage Tank

Length	: 450mm
Diameter	: 270mm
Thickness	: 7mm
Capacity	: 90pounds
Material	: MS

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VII.CONCLUSION

The technology of compressed air vehicles is not new. In fact, it has been around for years. Compressed air technology allows engines that are both non-polluting and economical. This paper explores the effective application of pneumatic power. Pneumatic vehicle will replace the battery operated vehicles used in industries. Pneumatic powered vehicle requires very less time for refueling as compared to battery operated vehicle. This is totally clean, light weight circuit, can work in hazardous environment and requires less maintenance.

VIII .ACKNOWLEDGEMENT

The submitting author is responsible for obtaining agreement of all co-authors and any consent required from sponsors before submitting a paper. It is the obligation of the authors to cite relevant prior work.

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