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DESIGN OF PNEUMATICALLY POWERED BICYCLE

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ABSTRACT

In current scenario, day by day increasing demand of fossil fuels had made everyone to look for other sources of energy. Few very popular energy resources used in researches are solar energy & electrical energy. What if our vehicles could run on air!What if your vehicle does not require any emission standards!What if your vehicle is pollution free! We could use pneumatic systems to produce the motion required and could be a little step towards developing a clean environment.

Keywords:-emissionstandards, pneumatic systems, extinction.

1. INTRODUCTION

Using a bicycle for short distance is a better option than traveling in other means because of its light weight and flexibility of movement. Electrical bicycles are available in the market but here we are trying to build a pneumatically operated bicycle. As we know in electrical bicycle if the load exceeds its limit there are chances that the system will get damaged where as in pneumatically operated bicycle this problem will be resolved as there will be no damage in the system because of over loading. Pneumatic vehicles have les operating cost then the electrical and internal combustion type.

In a pneumatic bicycle the source of energy is air. Here efforts are made to develop a hybrid bicyclic, which is pedalled manually and can run by compressed air power. A pneumatic bicycle comprises of pneumatic cylinders which is connected to the sprocket and the motion provided by the air to the pneumatic cylinder is in the reciprocating form which is converted to rotational motion with the help of sprocket.

2. LITERATURE REVIEW

There were many researchers conducted researches on pneumatic vehicle some which are:

RESEARCHER	RESEARCH
S.S. VERMA (2008)	In this research a light weight vehicle was introduced. A moped was formed by converting a normal scooter.
V. Lohit A. Imran Mohideen (October 2014)	In this research an internal combustion engine is replaced with pneumatic powered engine. That is the piston of the IC engine is replaced with pneumatic cylinder. And the reciprocating motion is provided by the pneumatic cylinder with the help of pressurized air.

Mr. Rixon K, Mohammad shareef V, Prajith K S, Sarath K, Sreejith S, Sreeraj P (03 March 2016)	In this research, a turbine is used to rotate the sprocket as it is bolted with it and the sprocket is chained with the wheel. When the pressurized air enters the turbine and expands it rotates the turbine and makes the sprocket rotate.

The main purpose of using pneumatic vehicle is it's eco-friendly, fuel is cheap and easily available and it has low running cost as compared to others. A pneumatic bicycle is light in weight and hence easy to carry.

3. OBJECTIVE

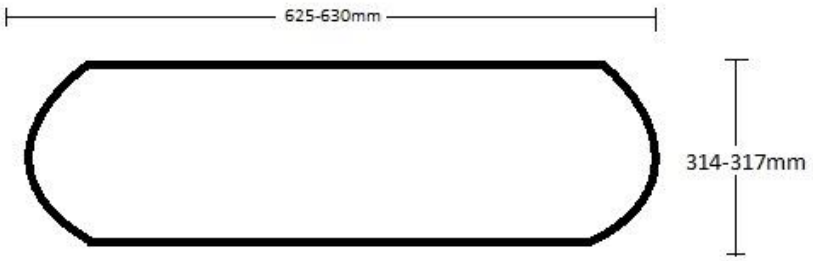
1. To obtain a pollution-free vehicle.
2. A vehicle with less running cost.
3. A vehicle that requires less maintenance.

4. COMPONENTS

1. **Air Compressor: -**air compressor is a device which sucks the air from the atmosphere and compresses the air. It works on the electric motor, diesel, gasoline engine, etc. It converts the potential energy of air into pressure energy of air. It will be used to fill the air tank but it won't be used in the cycle. Here a reciprocating type of compressor is used to fill the air tank.

https://4.imimg.com/data4/OQ/VC/MY-12365016/car-inflatable-pump-air-compressor-500x500.jpg

2. **Air tank: -**Air tank is a device used to store compressed air and supply it when needed. They are used to provide uniform air flow in the system. Here an alloy steel cylinder is used with a capacity of 25 litres. The rate of flow during fueling of cylinder will be between 0.5 to 25 liter/min. The empty cylinder weight is 14.2kg.



3. **Pneumatic cylinder and piston** -pneumatic cylinders are actuators used to provide reciprocating motion with the help of compressed air. Here a double acting pneumatic cylinder is used. In this paper two pneumatic cylinders are used. A double acting pneumatic cylinder has two working ports.

https://5.imimg.com/data5/MT/FF/MY-2128278/double-acting-air-cylinder-500x500.jpg

4. **Hose pipes: -** Hose pipes are used to connect the components and guide the air in the system.Here the pipe used has a burst pressure of 35 bars. The material used in hose pipe here is synthetic rubber.

https://www.google.com/search?q=hose+pipe+use+for+10+bar+pnematic+pressure&tbm=isch&ved=2ahUKEwjDqryOvoPhAhVDRY8KHfWWDV0Q2-cCegQIABAC&oq=hose+pipe+use+for+10+bar+pnematic+pressure&gs_l=mobile-gws-wiz-img.12...0.0..5675...0.0..0.0.0.....0.dplffyAdpEk&ei=mkGLXMP1O8OKvQT1rbboBQ&bih=591&biw=360&client=ms-android-xiaomi-rev1&prmd=isnv#imgrc=96PW8IrBns40XMg

5. **5/2 Way Solenoid valve: -** solenoid valves are used to regulate supply and provide direction to the fluid.. A solenoid valve is used to control a double acting pneumatic cylinder. Here it is used to control the flow of air in the two double acting pneumatic cylinders It has one inlet port ,two outlet ports and two exhaust ports.

https://images.homedepot-static.com/productImages/9d3b092f-3a0a-4488-befb-004e7b7f9ce9/svn/viair-compressor-accessories-92175-64_1000.jpg

6. **Safety valve: -** It fails itself before the system gets damaged.

https://images.homedepot-static.com/productImages/9d3b092f-3a0a-4488-befb-004e7b7f9ce9/svn/viair-compressor-accessories-92175-64_1000.jpg

7. **Pressure gauge: -** It is used to measure the pressure of the system.

https://www.heinowinter.com/SyMedien/daten/bilder/1500/Manometer-0...-25-bar-100mm-Anschluss-unten-ohne-Rand_13003183_heinowinter-com_0.jpg

8. **ON/OFF valve: -** ON/OFF valve turns the flow of air on and off.

http://i.ebayimg.com/00/s/MzY3WDM5Nw==/z/0cEAAOxycmBS-0By/$_3.JPG?set_id=2

9. **Bicycle frame**

https://s3.ap-south-1.amazonaws.com/choosemybicycle/static/images/cktips/NewFrame.jpg

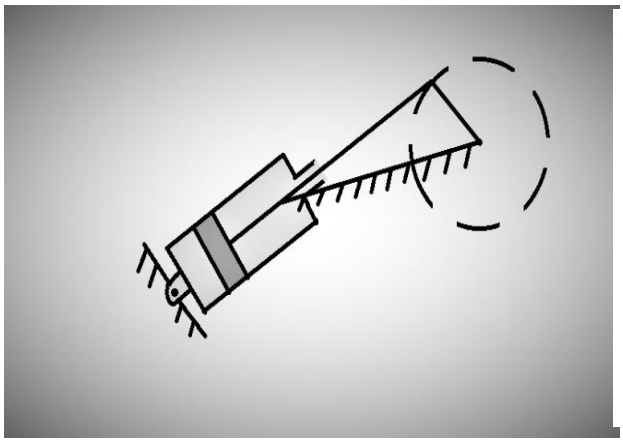
5. METHODOLOGY

A reservoir tank is filled with compressed air, a pressure gauge is fitted to the tank to measure the pressure in it. The air present in the tank is supplied to the pneumatic cylinders with the help of a 5/2 solenoid valve. The solenoid valve is used to ensure that both the cylinders get filled one by one not at the same time. The piston of the pneumatic cylinder is attached to the additional small sprocket which is further connected to another sprocket mounted on the main sprocket. When the air from the tank is passed to the pneumatic cylinder its piston provides a linear motion which is further converted into the rotary motion with the help of sprockets and as the sprockets rotate the wheels rotate and hence the bicycle starts running. The pneumatic cylinders are made to move in such a manner that when the piston of one cylinder is at its top dead end the other one is at its bottom dead end.

5.1 MECHANISM USED:

5.1.1 SINGLE SLIDER CRANK MECHANISM: It is a four bar chain mechanism in which there are one sliding pair and three turning pairs which convert reciprocating motion into rotary motion and vice versa.

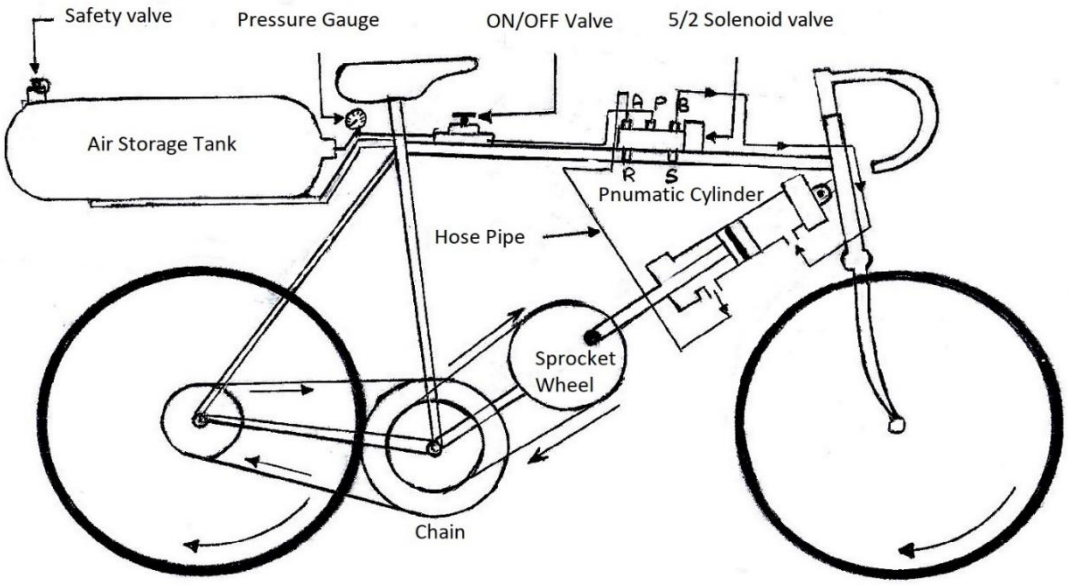
5.1.2OSCILLATING CYLINDER ENGINE MECHANISM: -it is an inversion of a single slider crank mechanism in which reciprocating motion is converted into rotary motion.



https://www.youtube.com/watch?v=UC3GtQjUpII

Fig. (a) Oscillating cylinder engine mechanism

6.DESIGN



6.1 Specifications:

Size	**26T**
Suspension	Rigid
Bike weight	17.80
Crankset	40T x 6 crank
Freewheel	18Teeth
Tube	28 x 1.5"

Hub	32/40 Holes
Frame material	STEEL
Brakes	Linkage Brake
Gears	SINGLE SPEED
Frame size	19.7 Inch
Pedals	Reflectorized Anti-Skid Pedal
Rim	Steel, 26 x 1-3/8 32/40H
Tyre size	26 x 1.5"

(Source - https://herocycles.com/Jet-Master-26T/product/87)

8. CALCULATIONS [2]

Maximum pressure =12 barAtmospheric pressure =1.013 bar

Operating pressure =5 bar Discharge =0.00191$m^{3/}$sec

Pneumatic cylinder

Piston diameter = 20mm stroke length = 250mm

Area of piston = $(\pi/4) \times d^2$ = 314mm^2= 0.000314m^2

Force generated by pneumatic cylinder = pressure × area of piston

$= 5\times10^5\times 0.000314$

= 157N

Consider 5% friction losses in pressure = 157×0.05

=7.85N

The total force on generated by pneumatic cylinder = 157 – 7.85

= 149.15N

Torque= force × perpendicular distance

= 149.15 × 0.06

= 8.949KN-m

9. CONCLUSION:-

In this paper, an approach is madeto design a pneumatically operated bicycle. This runs with the help of single slider crank mechanism. This paper describes the effective application of pneumatic power.

10. FUTURE SCOPE

In the future, the fiber made reservoir tank can be used, reduce the weight of the system, load carrying capacity can be increased and its torque can also be increased.

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