International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume – 02, Issue – 05, May – 2017, PP – 97-103

Crank Operated Motor Bicycle

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Abstract *: People ride bikes for a whole list of reasons, some to avoid walking and some for their own personal usage. There has been a drastic increase in the usage of motor bicycle which has lead to the environmental pollution. Thus to avoid this problem, we have decided to turn a bicycle into a motorcycle in one of the most unique ways ever by installing a crank setup attached to the engine. In this project we have tried to produce the compressed air with motion of the piston, which is stored in a storage tank, and is utilized again to run the bicycle.*

Keywords: *Cylinder, Flywheel, Piston, Storage tank, Two stroke engine,*

1. Introduction

As the resources are getting depleted, it's been a global issue to minimize the wastage of resources that is taking place. The fuel consumption worldwide is increased so much that the amount of pollution and depletion of resource (in the form of fuel) is not under control. Thus the bicycles might be an alternate solution for the above problem mentioned. In our project, we have tried to develop a prototype which consists of a crank operated motor bicycle, whose main function to use the air as its working medium. The whole setup provides the best product possible product at the most reasonable price. In the future we hope to be able to partner with one of the many non-profit organizations, so as to obtain a safer and a pollution free environment. Motorized bicycle is a bicycle with an attached motor and transmission used either to power the vehicle unassisted, or to assist with pedaling. Since it always retains both pedals and a discrete connected drive for rider-powered propulsion, the motorized bicycle in technical terms is a true bicycle, albeit a power-assisted one. Powered by a variety of engine types and designs, the motorized bicycle formed the prototype for what would later become the motorcycle. One alternative of using this is to increase bicycling which could reduce the need for taking car or public transport short distances as well as reduce congestion. One of the methods to increase bicycling in cities is to set up Bicycle Sharing Systems that can be accessed by locals or tourists for a fee. By providing a large network of stations with shared bicycles, it is possible to supply an efficient, convenient and cheap mode of transport. In this set-up we strap a two-stroke engine on a bicycle to create a moped.

The earliest motorized bicycles were ordinary utility bicycles fitted with an add-on motor and transmission to assist normal pedal propulsion, and it is this form that principally distinguishes the motorized bicycle from a moped or motorcycle. In a day when gasoline engine and transmission designs were in their infancy and power-to-weight ratios were low, a dual-purpose propulsion system seemed particularly advantageous. As time went on, pedal propulsion was increasingly replaced by constant use of a two or four-stroke gasoline engine. Nevertheless, the concept of using motor assist for the ordinary bicycle has persisted, and the concept has periodically resurfaced over the years, particularly in times of austerity or fuel shortages. In countries where automobiles and fuels are prohibitively expensive, the motorized bicycle has enjoyed continued popularity as a primary mode of transportation. The design of the motorized bicycle or motorbike varies widely according to intended use. Being an crank operated engine, lubrication is an issue. The crankshaft's ball bearing is lubricated by some thick oil in a gravity fed cup. Even though the engine is a two-stroke, some oil to the gas to keep the rings happy. The camshaft and connecting rod use bearings. While they don't have an automatic oiling system, they do look pretty well lubricated in the video. Starting the engine is a breeze, created a lever which holds the exhaust valve open. This acts as a compression release. It also has a lever which lifts the entire engine and friction drive off the rear wheel. All one has to do is pedal up to cruising speed, engage the friction drive, then disengage the compression release, it works rather well. Some motorized bicycles are powerful enough to be self-propelled, without use of the pedals. A development of the motorized bicycle is the moped, which commonly has only a vestigial pedal drive fitted primarily to satisfy legal requirements, and suitable only for starting the engine or for emergency use. The alternate design philosophy to the moped is the so-called motor-assist or pedal-assist bicycle. These machines utilize the pedals as the dominant form of propulsion, with the motor used only to give extra assistance when needed for hills or long journeys.

2. Literature survey

Today, motorized bicycles are still being developed both as complete designs and as add-on motor kits for use on standard bicycles, either by part-time hobbyists or by commercial manufacturers. With the development of new, lighter, and more powerful batteries, electric motors for power assist are increasingly popular, often using hub motors to facilitate after-market conversions. Converting bicycles or tricycles has proven useful for some people with physical disabilities such as knee injury or arthritis. Currently there are several companies manufacturing aftermarket internal combustion engine (ICE) motor conversion kits for conventional bicycles. These include both four-stroke and two-stroke gasoline engine designs. Among these, Golden Eagle Bike Engineers currently produces a rear-engine (rack-mounted) kit using a belt to drive the rear wheel. Staton-Inc, a motorized bicycle manufacturer of long standing, also uses a rack-mount with either a tire roller-mount (friction drive) or a chain-driven, geared transmission. Other manufacturers produce kits using small two- or four-stroke gas engines mounted in the central portion of the bicycle frame, and incorporating various types of belt- or chain-driven transmissions and final drives. Motorized bicycles using electric motors have also re-entered the market. Which have a limited capacity and thus a limited range, particularly when large amounts of power are utilized.

This design limitation means that the use of the electric motor as an assist to pedal propulsion is more emphasized than is the case with an internal combustion engine. While costly, new types of lithium batteries along with electronic controls now offer users increased power and range while reducing overall weight. Newer electric motor bicycle designs are gaining increasing acceptance, particularly in countries where increasing traffic congestion, aging populations, and concern for the environment have stimulated development and usage. So far very few people have carried out this project concept and they have used fuel as the working medium to run the bicycle. Since they have used fuel as the working medium, they came across many problems. Thus to avoid these issues, we are modifying petrol engine for alternate fuelling using Compressed Natural Gas (CNG). It provides an analytical background in the modification design process. A petrol engine TVS 2.0 auto which has a compression ratio of 9.8 was selected as case study. In order for this petrol engine to run on CNG, its compression had to be increased. An optimal ratio of 11.97 was computed using the standard temperature – specific volume relationship for an isentropic compression process. This computation of compression ratio is based on an inlet air temperature of 30°C (representative of tropical ambient condition) and pre combustion temperature of 540°C (corresponding to the auto-ignition temperature of CNG). Using this value of compression ratio, a dimensional modification Quantity =1.803mm was obtained to increase the using simple geometric relationships. This value of 1.803mm is needed increase the length of the connecting rod, the compression height of the piston or reducing the sealing plate's thickness. After the modification process, a CNG engine of air standard efficiency 62.7% (this represents a 4.67% increase over the petrol engine), capable of minimum power of 83.6KW at 6500rpm, was obtained. The world today is lamenting the disastrous consequences of climate change and leading technologies are searching for alternative fuels, according to Patil et al [1].

3. Working principle and components used

Our compressed air engine works on the same principle as that of an internal combustion engine. The only difference between the two is that, in an internal combustion engine the combustion of the fuel cylinder produces the energy to move the piston, while in an air driven engine the energy for moving piston is acquired from the supplied compressed air. The complete assembly of our air engine consists of slightly modified IC engine, solenoid valve, valve actuation system, piping system, gauge system, compressor air storage tank. For the proper and continues working of the engine the timing with which the compressed air is supplied is of great importance. So in order to make it precise we use a pressure gauge to control the flow of compressed air to the engine. For that, the outer region of the flywheel was marked when the piston was just about to reach the Top Dead Centre (TDC). By the same method the point just before the Bottom Dead Centre (BDC) was marked. The distance between the two points was calculated and a bent metallic plate of that exact length was welded between the two points. For starting, the engine is cranked manually. This will rotate the crankshaft along with the flywheel in the clockwise direction. During this rotation the roller attached to the push button operated solenoid valve moves over the bent plate. At that moment the valve gets opened and allows the flow of compressed air into the cylinder through the piping system. So all the way long the valve remains open thereby ensuring a continuous supply of air to the engine. Thus the piston is pushed further towards the BDC. But for efficient utilization of the compressed air the supply should be cut off before the piston reaches BDC. This is done with more ease as the roller will come down from the curved path before reaching BDC resulting in closing of the valve.

During the return of the piston to TDC the roller of the valve moves over the surface of the flywheel thus ensuring closure of the valve and this cycle continues as shown in Fig. 1.

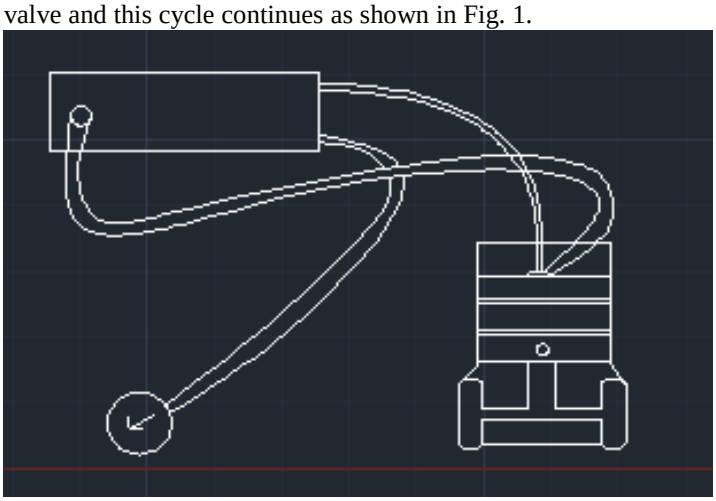

Fig. 1 working principle of crank operated set up

The main components used to fabricate the model are:

- Two stroke engine
- Cylinder
- Cylinder head
- Flywheel
- Piston
- Ball bearings
- Pressure gauge
- Storage tank
- Solenoid valve
- Piping system
- Chain sprocket

3.1 Two stroke engine

A two-stroke, or two-cycle, engine is a type of internal combustion engine which completes a power cycle with two strokes of the piston during only one crankshaft revolution. In a two-stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust functions occurring at the same time. Two-stroke engines often have a high power-to-weight ratio, usually in a narrow range of rotational speeds. Compared to four-stroke engines, two-stroke engines have a greatly reduced number of moving parts, and so can be more compact and significantly lighter. In a two-stroke engine, the heat transfer from the engine to the cooling system is less than in a four-stroke, which means that two-stroke engines can be more efficient.

3.2 Cylinder

A cylinder is a solid geometric shape that always has two ends lying parallel to each other and connected by a single side with a circular cross-section. A cylinder is the central working part of a reciprocating engine or pump, the space in which a piston travels. The ends of a cylinder, which are called it is bases, are usually circular but can be elliptical. The reciprocating motion of the pistons is translated into crankshaft rotation via connecting rods. As a piston moves back and forth, a connecting rod changes its angle, its distal end has a rotating link to the crankshaft.

A cylinder with circular bases is known as a right cylinder because its bases lie perpendicular to the shape's axis at a 90-degree right angle. Cylinders, both naturally occurring and artificial, are abundant in the world. Circles are naturally formed by many processes, and joining them to form a cylinder is no more complicated than rolling up a rectangle until its edges meet.

3.3 Cylinder head

The cylinder head is the central working part of a reciprocating engine the space in which a piston travels. A cylinder displacement, or swept volume, can be calculated by multiplying its cross-sectional area (the square of half the bore by pi) and again by the distance the piston travels within the cylinder (the stroke). The engine displacement can be calculated by multiplying the swept volume of one cylinder by the number of cylinders.The basic engine that we have used in the project is a normal two stroke petrol engine.

The details of the engine are as follows:

- Engine type: TVS 2-stroke 50 cc
- Stroke length: 42 mm
- Bore diameter: 46 mm
- Number of cylinders: 1

3.4 Flywheel

A flywheel is used to store energy. When torque is applied to a flywheel, its energy is conserved in its rotational momentum. When the energy is needed, the energy is harvested and the wheel slows down. The rotation of a flywheel slows down slightly over time. A spinning top is a good example of how rotation stays relatively constant. Early flywheels were limited by their mechanical construction, but modern flywheels been replaced. Early flywheels were used as pottery wheels, and they were later used in steam engines. Modern flywheels are often used to generate mechanical and electrical energy, and some are exploring using flywheels for hybrid automobiles. Flywheel energy storage (FES) works by accelerating a rotor (flywheel) to a very high speed and maintaining the energy in the system as rotational energy. When energy is extracted from the system, the flywheel's rotational speed is reduced as a consequence of the principle of conservation of energy, adding energy to the system correspondingly results in an increase in the speed of the flywheel.

3.5 Piston

A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. An internal combustion engine is acted upon by the pressure of the expanding combustion gases in the combustion chamber space at the top of the cylinder. This force then acts downwards through the connecting rod and onto the crankshaft. The connecting rod is attached to the piston by a swiveling gudgeon pin. This pin is mounted within the piston: unlike the steam engine, there is no piston rod or crosshead (except big two stroke engines).Pistons are cast from aluminum alloys. For better strength and fatigue life, some racing pistons may be forged instead. Early pistons were of cast iron, but there were obvious benefits for engine balancing if a lighter alloy could be used. To produce pistons that could survive engine combustion temperatures, it was necessary to develop new alloys such as Y alloy and Hiduminium, specifically for use as pistons.

3.6 Ball bearings

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads.Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g. a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. An angular contact ball bearing uses axially asymmetric races. An axial load passes in a straight line through the bearing, whereas a radial load takes an oblique path that tends to want to separate the races axially.

3.7 Pressure gauge

Instruments used to measure pressure are called pressure gauges or vacuum gauges. Pressure measurements, such as for tire pressure, are usually made relative to ambient air pressure. In other cases measurements are made relative to a vacuum or to some other specific reference

3.8 Storage tank

A Storage tank is a container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. The pressure differential is dangerous, and fatal accidents have occurred in the history of pressure vessel development and operation. Consequently, pressure vessel design, manufacture, and operation are regulated by engineering authorities backed by legislation. For these reasons, the definition of a pressure vessel varies from country to country, but involves parameters such as maximum safe operating pressure and temperature, and are engineered with a safety factor, corrosion allowance, minimum design temperature (for brittle fracture), and involve nondestructive testing, such as ultrasonic testing, radiography, and pressure tests, usually involving water, also known as a hydro test, but could be pneumatically tested involving air or another gas. The preferred test is hydrostatic testing because Its a much safer method of testing as it releases much less energy if fracture were to occur (water does not rapidly increase its volume while rapid depressurization occurs, unlike gases like air, i.e. gasses fail explosively).Storage tank is also used for supplying high-pressure clean air to fill gas cylinders, supplying moderate-pressure clean air to a submerged surface supplied diver, supplying moderate-pressure clean air for driving some office and school building pneumatic control system valves, supplying a large amount of moderate-pressure air to power pneumatic tools, such as jackhammers, for filling tires, and to produce large volumes of moderate-pressure air for large-scale industrial processes. It is also used in scuba diving for carrying the breathing air required while underwater.

3.9 Solenoid valve

A solenoid valve is an electromechanical controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core in its centre. This core is called the plunger. In rest position, the plunger closes off a small orifice. An electric current through the coil creates a magnetic field. The magnetic field exerts a force on the plunger. As a result, the plunger is pulled toward the centre of the coil so that the orifice opens. This is the basic principle that is used to open and close solenoid valves. Pneumatic Valves are as devices to control or regulate the commencement, termination and direction and also the pressure or rate of flow of air under pressure which is delivered by a compressor or vacuum pump or is stored in a vessel.The type of valve used is of little importance in a pneumatic control for most part. What is important is the function that can be initiated with the valves, its mode of actuation and line connection size, the last named characteristics also determining the flow size of the valve.

3.10 Piping system

The pipe system is used to connect the components involved in the passage of the compressed air. It is used to connect the cylinder to the valve and the solenoid valve to the cylinder head. Here nylon pipes are used of diameter of 12mm and length of 1m. Nylon tube is manufactured from virgin granules of Nylon-6, Nylon-66, Nylon-11, and Nylon-12, also known as Polyamide or PA6, PA66, PA11 & PA12. While installation, take proper care not to give excessive bend and twist or tension to tube because the tube may get kinking and leads to damage or even breakage. Do not forget to observe the rule of minimum bend radius rule for each size of nylon tube as different sizes have different bend radii. Careful laying of tube will also give protection against abrasion. Possible effect of shrinkage will be compensated by allowing sufficient length of tube. End fittings should be used as per best practice in the industry. While making end fitting connection, make it sure the tube ends are cut at right angles and the cross section of tube does not look elliptical. If this is not followed properly, leakage may occur at the fitting. Tube fittings specially developed for nylon tubing are the best alternative.

3.11Chain sprocket

Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles. Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange.

Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

The final assembly of crank operated motor bicycle is shown in Fig. 2.

Fig. 2crank assembly setup

4. Advantage,disadvantage and future scope of the proposed machine

The advantages, disadvantages, applications and future scope of this proposed model are:

4.1 Advantages

The advantages are as follows:

- Much like electrical vehicles, air powered vehicles would ultimately be powered through the compressed air. This makes it easier to focus on reducing pollution from one source, as opposed to the millions of vehicles on the road.
- Compressed-air technology reduces the cost of vehicle production by about, because there is no need to build a fuel tank, Ignition Systems or silencers.
- The engine can be massively reduced in size.
- Low manufacture and maintenance costs.
- The air tank may be refilled in less time.
- Less stress and easy to handle.
- No pollution effect on the environment.
- Easy to assemble and disassemble.
- Compressed air is easily regenerated

4.2 Disadvantages

The disadvantages are as follows:

- Since the cylinder arrangement is modified, a frequent maintenance is required.
- The set is exposed to atmosphere, thus in rainy season rusting of parts can take place.

4.3 Future scope

- Can implement for large industries.
- By changing cutter shape we can cut paper with different designs.
- By modifying Geneva slots we can cut different standard size paper.
- Machine can be modified to cut lather and other thick sheets.
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4. Conclusion

It is important to remember that while vehicles running on only compressed air might seem like a distant dream, but they still have public interest due to their environmental friendly nature. Efforts should be to make them light, safe, cost effective and economical for deriving. The storage of compressed air (initially as well as during journey) with all benefits like no heating, high energy density and provisions to make use of cooling produced during adiabatic expansion during the energy release have to be taken care off in a much more controlled manner. Electric-powered cars and bikes already available on the market put a strong competition to compressed air car not only in terms of cost but also their environment friendly role. The technology still looks distant but that has not deterred inventors from working on it. By doing this project one can gained the knowledge about pneumatic system. We were also able to gain practical knowledge about the basics of the normal IC engine and solenoid valves. The Compressed Air Engine provides an effective method for power production and transmission. Even though its applications are limited currently, further research could provide wider applications.

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