A Review On: Design & Modeling of Compressor Driven Vehicle

Bhushan Joil[1] Arbaj Sayyad[2] Taiyyab Sheikh[3] Pravin Bamdale[4] Reshma Patil[5]
[1,2,3,4]Student [5]Assistant Professor
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Alard College of Engineering & Management, Hinjewadi, India

Abstract— A compressor driven vehicle is an eco-friendly vehicle which operates with compressed air. A compressor driven vehicle uses the expansion of compressed air to drive the pistons of an engine. A compressor driven vehicle is a pneumatic actuator that creates useful work by expanding compressed air. Since, there is no combustion; there will be no mixing of fuel with air takes place. A compressor driven vehicle makes use of Compressed air technology for its operation. The Compressed air technology is quite simple in its operation. It works as we compress normal air into a cylinder, the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do useful work. So, this energy in compressed air can also be utilized to displace a piston.

Keywords: compressor, pneumatic system, compressor driven vehicle, compressed air

I. INTRODUCTION

The exhaust emission standard are getting more and more stringent and there now exits a discussion about the introduction of a mandatory emission standard of CO_2, a greenhouse gas that contributes to the climate change which is an issue of growing international concern. This demand for lower exhaust emission levels together with increasing fuel prices leads to the demand for combustion engine with better fuel economy which forces engine developers to find and investigate more efficient alternate engine management.

A Compressor Driven Vehicle makes use of Compressed Air Technology for its operation. If we compress normal air into a cylinder the air would hold some energy within it. This energy can be utilized for useful purposes. When this compressed air expands, the energy is released to do work.

So this energy in compressed air can also be utilized to displace a piston. This is the basic working principle of the Air Driven Engine. It uses the expansion of compressed air to drive the pistons of the engine. So A Compressor Driven Vehicle is basically a pneumatic actuator that creates useful work by expanding compressed air. This work provided by the air is utilized to supply power to the crankshaft of the engine.

In the case of a Compressor Driven Vehicle, there is no combustion taking place within the engine. So it is non-polluting and less dangerous. It requires lighter metal only since it does not have to withstand elevated temperatures. As there is no combustion taking place, there is no need for mixing fuel and air. Here compressed air is the fuel and it is directly fed into the piston cylinder arrangement. It simply expands inside the cylinder and does useful work on the piston. This work done on the piston provides sufficient power to rack and pinion.

II. LITERATURE REVIEW

Mistry Manish K., January-March 2012 "This paper is reports on the review of compressed air engine for the design and development of single cylinder engine which can be run by the compressed air."

Sanket H. S., Oct 2018, "Study of torque and pressure relation with speed."

Sapkal Vishal K., March 2015, "Case study on Air powered vehicle Future trends in automobiles: Air Powered Vehicle."

Manjunath B. A., 2017, "This paper is describes about Manufacturing of 3 wheel air driven vehicle."

A. Keste, 2013, "This paper describes the working of a vehicle which works on pneumatic power."

III. DESIGN CONSIDERATIONS AND PROCEDURE

A. System Design

System design mainly concerns the various physical constraints and ergonomics, space requirements, arrangement of various components on main frame at system, user friendliness, No. of controls, position of controls, working environment of machine, chances of failure, safety measures to be provided, servicing aids, ease of maintenance, scope of improvement, weight of machine from ground level, total weight of machine and a lot more.

In system design we mainly concentrated on the following parameters

1) System Selection Based on Physical Constraints

Space occupied is always a major concern. The system is to be very compact so that it can be adjusted to corner of a room. The mechanical design has direct norms with the system design. Hence the foremost job is to control the physical parameters, so that the distinctions obtained after mechanical design can be well fitted into it.

2) Arrangement of Various Components

Keeping into view the space restrictions the components should be laid such that their easy removal or servicing is possible. More over every component should be easily seen. Every possible space is utilized in component arrangements

3) Components of System

As already stated the system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact. A compact system design gives a high weighted structure.

4) User-Friendly Controls

The friendliness of a machine with the operator that is operating is an important criteria of design. It gives easier control over the machines.

5) Chances of Failure

The loss incurred by the owner in case of any failure is an important criteria of design. Factor safety while doing mechanical design is kept high so that there are less chances

of failure. Moreover periodic maintenance is required to keep unit healthy.

6) Servicing Facility

The layout of components should be such that easy servicing is possible. Especially those components which require frequents servicing can be easily disassembled.

7) Height of Machine from Ground

For ease and comfort of operator the height of machine should be properly decided so that he may not get tired during operation. The machine should be slightly higher than the waist level, also enough clearance should be provided from the ground for cleaning purpose.

8) Weight of Machine

The total weight depends upon the selection of material components as well as the dimension of components. A heavier machine is difficult in transportation & in case of major breakdown; it is difficult to take it to workshop because of more weight .

B. Calculation

1) Brake Power

Brake horsepower is the measure of an engine's horsepower without the loss in power caused by the gearbox, alternator, differential, water pump, and other auxiliary components such as power steering pump, muffled exhaust system, etc. Brake refers to a device which was used to load an engine and hold it at a desired RPM. During testing, the output torque and rotational speed were measured to determine the brake horsepower. Horsepower was originally measured and calculated by use of a brake drum connected to the engine's output shaft. Brake power is the power produced by the engine as measured by the brake drum.

Brake power 'BP'

$$\left\{\left[\frac{2\pi N}{60}\right] * \left[\frac{D+d}{2}\right] * [w1 - w2] * g\right\} w$$

Where;

w1 = weight added in kg,

w2 = load shown in spring balance in kg,

N = speed in RPM,

d = diameter of rope in mm,

Sample Calculations:

pressure at 5 bar and 3 kg load

Torque = (w1-w2)*[(D+d)/2]*g

= (3-0.1) *[(0.12+0.012)/2]*9.81

Brake power 'BP' =

$$\left\{\left[\frac{2\pi N}{60}\right] * \left[\frac{D+d}{2}\right] * [w1 - w2] * g\right\} w$$

BP = (2*π*438/60) *[(0.12+0.012)/2]*(3-0.1)*9.81 W

=45.86 * 0.132 * 2.9 *9.81 watts

= 172.22 watt

C. Design

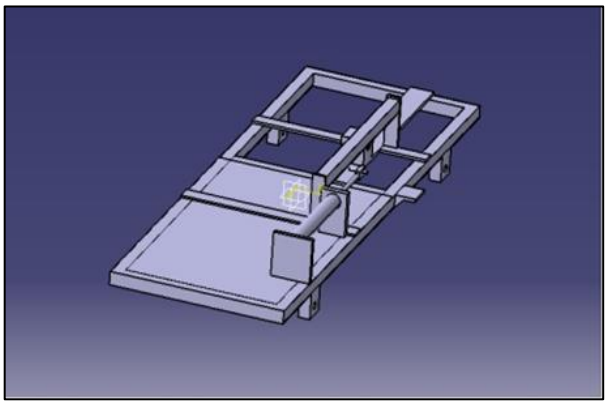

Fig. 1: Base Frame

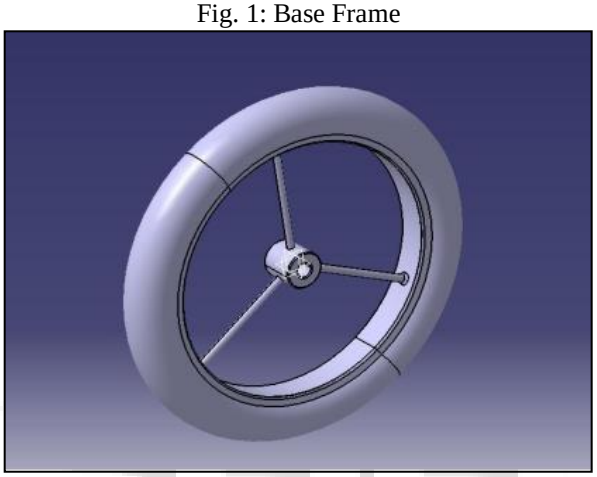

Fig. 2: Wheel

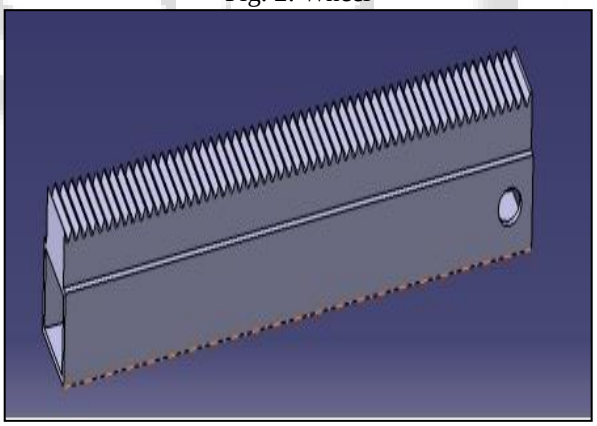

Fig. 3: Rack

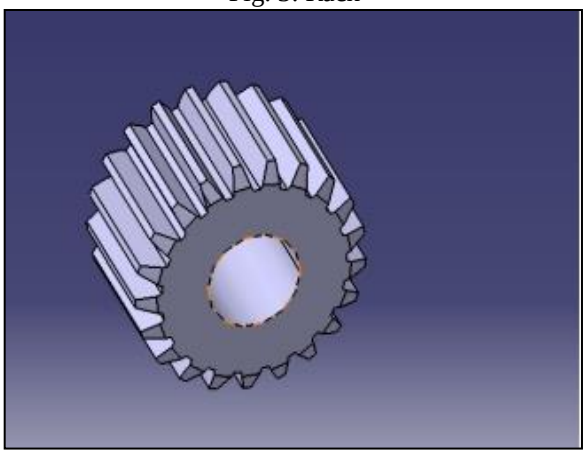

Fig. 4: Pinion

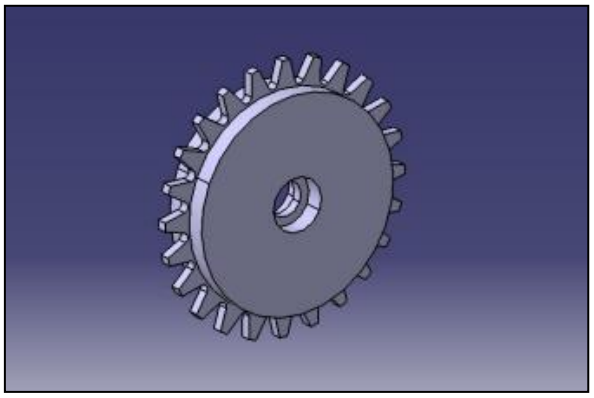

Fig. 5: Ratchet

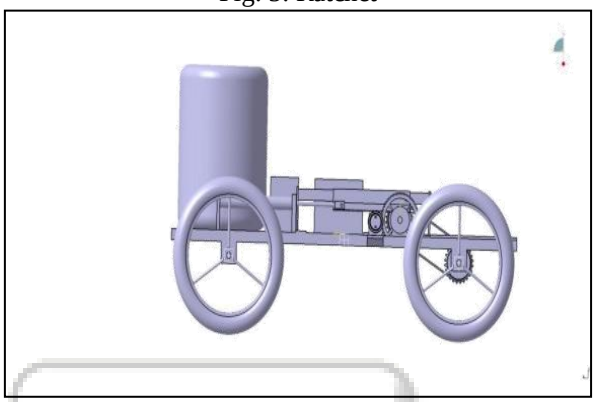

Fig. 6: Assembly Front view

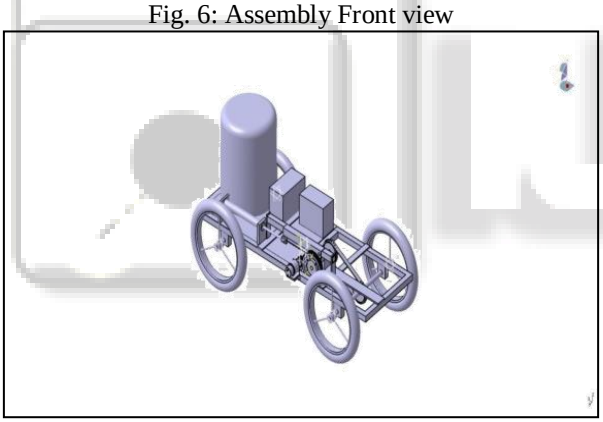

Fig. 7: Assembly isometric view

IV. ADVANTAGES

1) Does not use expensive fuels like petrol or diesel.
2) Lighter vehicles.
3) Transportation of fuel of oil from reservoirs is not required.
4) Reduces the chances of fire because of the non-flammable fuel used.
5) Simple in construction.

V. CONCLUSION

Compressed Air driven vehicle is cheaper in cost and maintenance, so it is easily used by industries for moving things from place to another in less energy consumption. It will help to control the serious problem of global warming. This review related to all design aspects and calculations based on selection of parts of vehicle. In future, using same design model is fabricated.

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