www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 6 Issue 6 June 2017, Page No. 21718-21725
Index Copernicus value (2015): 58.10 DOI: 10.18535/ijecs/v6i6.27

Design and Manufacturing of Pneumatic Vehicle for Industrial Purpose

Karan R. Jagtap[1], Swapnil A. Patil[2], Shripad P. Raje[3], Sachin R. Pawar[4], Prof. Vinay J. Raje[5]
[1,2,3,4]Final Year Student,
Dept. of Mechanical Engg; JSPM NTC, Narhe Pune, India
kj.jagtap@gmail.com
[5]Associate Professor,
Dept. of Mechanical Engg; JSPM NTC, Narhe Pune, India
rajevinay1@gmail.com

Abstract— *Compressed air as a source of energy in different uses in general and as a non-polluting fuel in compressed air vehicles has attracted scientists and engineers for centuries. Efforts are being made by many developers and manufacturers to master the compressed air vehicle technology in all respects for its earliest use by the mankind. Nowadays, almost every industry is trying to develop light and efficient vehicles. Today, all the the vehicles running on conventional & non-conventional fuels are known for producing a large amount of harmful gases like CO_2, SO_2, NO_2, etc. which acts increases global warming. The motto of our project is to design & fabricate vehicle running on air pressure for material handling in industries and reduce power consumption. It is rear wheel drive. We develop the concept of pneumatic vehicle from pedal operated tricycle. The vehicle looks like three wheeler in which manual operation is replaced by compressed air pressure. The following report gives a brief description of how a compressed air vehicle using this technology was made. While developing of this vehicle, control of compressed air parameters like temperature, energy density, requirement of input power, energy release and emission control have to be mastered for the development of a safe, light and cost effective compressed air vehicle in near future.*

Keywords— air pressure, compressed air vehicle, design and fabricate, emission control, energy input, energy released, rear wheel drive, storage & fueling, temperature.

I. INTRODUCTION

Storing Compressed air into a small air tank and then using it for actuation of the vehicle. This is the basic principle behind this vehicle. In this vehicle, the energy of compressed air filled inside the tank mounted on the vehicle is utilized. This compressed air actuates double acting cylinder and with the help of chain drive the actuation of the vehicle takes place. We designed this vehicle to carry the weight of one person of 45 kg. For ignition we have used the battery. The vehicles capacity is less due to small size of the air tank.

The prototype of vehicle works on the principle of compressed air filled in the air tank for actuation of the vehicle. The air tank fitted on the vehicle is a compact unit. The vehicle runs by the reciprocating action of the piston in the cylinder by the power supplied by it to the gears.

The gears transmit this rotating movement of the gears to the chain drive and this drive is connected to the shaft of the rear wheels and thus the vehicle runs.

The objective of the vehicle is to minimize the pollution to the environment and to overcome the rising prices of the petrol and diesel as it is the most important concept of the common man's life. This principle can mainly used for transportation of material and parts in the industries.

Pneumatic vehicle, also called air vehicles, use air to transport one location to another. Pneumatic vehicle systems do this by generating air pressure levels measuring either above or below the atmospheric pressure to move the materials through pipes or tubes or by converting the pressure in to movement of mechanical device used as transport equipment in the vehicle system to the required destination.

The word pneumatic come from the Greek word 'pneuma' means 'air' or 'wind'. Tool and appliance driven by compressed air are known as pneumatic devices. In some cases, air suction instead of compression is used to operate the tool or appliance, as in the vacuum cleaner. Example of these devices are pneumatic –Vehicle, rock – drills, Jackhammers, spray and airbrakes.

These consist of pneumatic cylinders, manual valves and a mini compressor. And this is not all. It is even possible to program and control these machines with a computer. Thus, "Pneumatic vehicle" combines two fascinating areas of technology, pneumatics and computing in one single kit.

Pneumatic actuators, usually cylinders, are widely used in factory floor automation. Lately, vehicle as well is starting to use pneumatics as a main motion power source. One of the major attractions about pneumatics is the low weight and the inherent compliant behavior of its actuators. Compliance is due to the compressibility of air and, as such, can be influenced by controlling the operating pressure.

This is an important feature whenever there is an interaction between man and machine or when delicate operations have to be carried out (e.g. handling of fragile objects). Several types of pneumatic actuators—e.g. cylinders, bellows, pneumatic engines and even pneumatic stepper motors—are commonly used to date. We used pneumatic system, as it has some advantages over the hydraulic system. There is no need for fluid replenishment. Light tubing/piping is sufficient. There is no fire hazard. But in our pneumatic system, we have used air as a working fluid. Because air has some advantages over other gases. Properties of air are very suitable for pneumatic system.

II. LITERATURE REVIEW

Anirudh Addala & Srinivasu Gangada (2013) [1] This research aims to examine the performance of a car which takes air as the working medium. Air car is a car currently being developed which is still in the R&D stage all over the world. Review on the availability and the impact of the fossil fuels in

the present and future generations led us to design a vehicle which runs by renewable energy sources. As the world is hard pressed with the energy and fuel crisis, compounded by pollution of all kinds,any technology that brings out the solution to this problem is considered as a bounty. In one of such new technologies, is the development of a new vehicle called as "Compressed Air Car", 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 exhaust is clean and cool air. Though some of the renewable energy sources like solar energy, bio fuels are currently in practice, we focused on pneumatic technology. Since pneumatic applications are wide all over the world, basic components and other equipment are easily available and the fabrication is not so tough. The basic principle involved in this concept is that compressed air is capable enough to provide sufficient thrust which in turn can propel the car. This report is a detailed description of the fabrication, working and testing of the compressed air car.

The laws of physics dictate that uncontained gases will fill any given space. The easiest way to see this in action is to inflate a balloon. The elastic skin of the balloon holds the air tightly 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 explodes. Compressing a gas into a small space is a way to store energy. When the gas expands again, that energy is released to do work. That's the basic principle behind what makes an air car move. Air car will have air compressor built into it. After a brisk drive, we can take the car home, put it into the garage and plug in the compressor. The compressor will use air from around the car to refill the compressed air tank. Unfortunately, this is a rather slow method of refueling and will probably take up few minutes for a complete refill. If the idea of an air car catches on, air refueling stations will become available at ordinary gas stations, where the tank can be refilled much more rapidly with air that's already been compressed. Filling your tank at the pump will probably take about three minutes. This air car will almost certainly use Compressed Air Motor (CAM)/ Pneumatic wrench. Air car propelled with this engine will have tanks that will probably hold compressed air to about 11.03 bar pressure. Its accelerator operates a valve on its tank that allows air to be released into the hoses and then into the motor, where the pressure of the air's expansion will push against the vanes and turn the rotor. This will produce enough power for speeds of about 15-20 kilometers per hour.

The technology of compressed air vehicles is not new. In fact, it has been around for years. Compressed air technology allows engines/ motors that are both nonpolluting and economical. After one year of research and development, our compressed air car is brought into existence. Unlike electric or hydrogen powered vehicles, compressed air car is not expensive. Compressed air car is affordable and have a performance rate whose power to weight ratio stands up to 0.0373kW/kg. For arriving at a fair power to weight ratio, we considered possible factors which would result to minimize the weight of the car. For this we designed 3 wheeled vehicles. The entire chassis is fabricated with 1 inch angular frames. Unlike conventional transmission systems which include clutch, counter shaft, fly wheel, propeller shaft, differential, our pneumatic motor is coupled to the rear wheel with intermediate gear box which greatly reduces the transmission losses and weight of the vehicle. It also occupies lesser space compared to a four wheeler. This car gives an economy of about Rs.1 per kilometer. At the same time the well to wheels efficiency of the vehicle need to be improved. This is a revolutionary design which is not only eco friendly, pollution free, but is also very economical. This addresses both the problems of fuel crisis and pollution. However excessive research is needed to completely prove the technology for both its commercial and technical viability. Our motto is to bring peace and tranquility to earth from pollution.

A.A.Keste, S. B. Vise [2] This paper describes the working of a vehicle which works on pneumatic power. A pneumatic vehicle uses compressed air as a source of energy for locomotion. In this system a double acting pneumatic cylinder is operated as a slider crank mechanism which converts the linear reciprocation of the cylinder piston rod into oscillatory motion of the driver crank about the pinion shaft. The battery operated vehicles used in all manufacturing industries has disadvantages like high weight, takes more time to charge the battery, critical connection of switches and relays and more maintenance. These stated problems in this paper are overcome by a pneumatically operated vehicle which has low weight, easy circuits, takes less time for refueling and requires less maintenance.

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. An inventor, Jem Stansfield has been able to convert a regular scooter to a compressed air moped. The moped has top speed of about 18 mph and could go 7 miles before its air pressure ran out. During literature survey it is observed that compressed air vehicles has many potential advantages over electric vehicles which includes no

degradation problems of batteries, time required for refueling the tank, easy disposal of compressed air tank without causing any pollution as with the batteries. Hence in order to overcome the above stated problems there is a need of eco-friendly vehicles using compressed air as a working medium in future. In this work a sincere effort is made to develop Vehicle operating on compressed air by inversion of slider crank mechanism.

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 converts 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 expandable substance, it is dangerous to use pneumatic cylinder at high pressure so they are limited to 8 bar (gauge) pressure. Consequently they are constructed from lighter material such as aluminum and brass. Because gas is compressible substance, the motion of 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 particular size of piston diameter, rod length and stroke length.

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 refuelling as compared to battery operated vehicle. This is totally clean, light weight circuit, can work in hazardous environment and requires less maintenance.

Mr. N. Govind, Mr. S. Sanyasi Rao (2015) [3] Compressed air as a source of energy in different uses in general and as a nonpolluting fuel in compressed air vehicles has attracted scientists and engineers for centuries. Efforts are being made by many developers and manufacturers to master the compressed air vehicle technology in all respects for its earliest use by the mankind. The present paper gives a brief description of how a compressed air vehicle using this technology was made. While developing of this vehicle, control of compressed air parameters like temperature, energy density, requirement of input power, energy release and emission control have to be mastered for the development of a safe, light and cost effective compressed air vehicle in near future.

A compressed-air engine is a pneumatic actuator that creates useful work by expanding the compressed air and converting the potential energy into motion. (A pneumatic actuator is a device that converts energy into motion.) The motion can be rotary or linear, depending on the type of actuator. Compressed Air Engine (CAE) are fueled by compressed air, which is stored in a tank at a high pressure. A Compressed Air Vehicle (CAV) uses this compressed-air engine as its mechanism for propulsion. . Compressed air vehicle project in the form of light utility vehicle (LUV) (i.e., air car in particular) has been a topic of great interest for the last decade and many theoretical and experimental investigations The difference between the compressed air engine and IC engine is that instead of mixing fuel with air and burning it to drive pistons with hot expanding gases, CAE's use the expansion of previously compressed air to drive their pistons. The greatest advantages of compressed air vehicle are, no burning process and no waste gas discharge to the surrounding environment. It can be said as a green environmental protection vehicle with near zero pollution in the metropolitan cities with the policy of energy conservation and environment protection. The engines of compressed air cars are piston type, vane type, rotary type and the piston engine. At present, the piston engine power system has some disadvantages such as complex structure, easy wearing, high noise and low efficiency. Therefore, to develop and optimize engine power system is the key technique for compressed air vehicles.

Chassis is made by arc welding at various sections for the Rectangular cross sections. The end joints re butt welded and some internal angular sections are lap welded. The steering column support is given by welding a hollow shaft with a T weld to the front frame of the chassis. The steering of a vehicle is so arranged that the front wheels will roll truly without any lateral slip. The function of the steering system is to convert the rotary movement of the steering wheel into angular turn of the front wheels. To keep effective control on the moving vehicle throughout its range of speed irrespective of the load and road conditions. The steering system of a vehicle should fulfill the following requirements:

1. It should multiply the effort applied on the steering wheel by the drivers.
2. The mechanism should have self-adjusting effect so that when the driver releases the steering wheel after negotiating the turn, the wheel should try to achieve straight ahead position.
3. It should not transmit road shocks to steering wheel.

The model designed by us is a small scale working mod-el of the compressed air engine. When scaled to higher level it can be used for driving automobiles independently or combined (hybrid) with other engines like I.C. engines. The technology of compressed air vehicles is not new. Compressed air technology allows for engines that are both non-polluting and economical. After ten years of research and development, the compressed air vehicle will be introduced worldwide. Unlike electric or hydro-gen powered vehicles, compressed air vehicles are not expensive and do not have a limited driving range. Compressed air vehicles are affordable and have a performance rate that stands up to current standards. To summit up, they are non-expensive cars that do not pollute and are easy to get around in cities. The emission benefits of introducing this zero emission technology are obvious At the same time the well to wheels efficiency of these vehicles need to be improved. This is a revolutionary car which is not only eco- friendly, pollution free, but also very economical. This addresses both the problems of fuel crises and pollution. However excessive research is needed to completely prove the technology for both its commercial and technical viability.

III. DEFINITION OF PROBLEM

DOI: 10.18535/ijecs/v6i6.27

Vehicles like forklifts, small cranes, etc. are used in industries for transportation purpose. These vehicles employ fuels like petrol and diesel. These fuels have harmful impacts on ozone layer and since these are fossil fuels their prices are rising day by day and at the same time their supply is also depleting. Hence there is a need to dvelop an alternative to these fuels. This can be achieved by using compressed air as the fuel to operate the vehicles mentioned above for industrial transportation. These vehicles make use of the energy of compressed air which is stored in the tank which is utilized to actuate a double acting cylinder which in turn rotates a spur gear through linkages rotating the rear axle, moving the vehicle forward.

IV. PROJECT OBJECTIVES

1. To design various components of compressed air vehicle using theoretical design formulae.
2. To manufacture the entire vehicle by the use of dimensions obtained from the theoretical design.
3. To use compressed air as a fuel to operate this vehicle thereby replacing the existing fuels like petrol and diesel.
4. To create a system which will be ecofriendly as well as economical for conveying industrial materials like sand, concrete, coal, assembly components, boxed packages, etc.
5. To modify the design of the pneumatic system by increasing the capacity of receiver tank, use of solenoid valve with a reset timmer and to achieve high strength to weight ratio increasing the efficiency.

V. METHODOLOGY

In this project a compressed air vehicle is designed and manufactured which includes the following components:

1. Chassis for mounting all components of the vehicle.
2. Air reciever tank for storing compressed air.
3. Design and selection of mechanical components like spur gear drive, chain drive and the corresponding linkages, also the selection of the suitable bearings.
4. Pneumatic system components like double acting cylinder, piston and piston rod and selection of the required valves and hoses.
5. Assembly of the above mentioned components to develop the vehicle.

VI. DESIGN CALCULATIONS

A. Mechanical Components

The design calculations for mechanical components of the vehicle are enlisted as follows:

1. Design of Chassis

Input Data

- TOTAL WEIGHT = 100 kg
- No of Links = 4

2 Links of 900 mm
1 Link of 600 mm
1 Link of 300 mm

Force = 100 kg
= 100 X 9.81
= 981 N
≈ 1000 N

No of Links = 4

Hence,

Force on each Link = 1000 / 4
= 250 N

Considering the max. value of FOS = 2
Buckling Load on each Link = 250 X 2
= 500 N

Let,
t_1 = Thickness of Link
b_1 = Width of Link
Area of Link = t_1 X b_1

Assuming,
Width of the Link = 3 X t_1

Hence,
b_1 = 3 X t_1
Area = 3t1
MI of Link, I = 1/12 X $t_1 . b_1$
= 2.25 t_1^4

Let,
K = Radius of Gyration
A = Area
K = √ I / A
K = 0.75 t_1
Link – 1
L_1 = 300 mm
Pr = 500 N
Rankine Constant = A = 1 / 7500
Crushing Load (Fy) = 325 Mpa for M.S.

Now, Buckling Load
Pr = Fy. A / 1 + A Λ
Where Λ = L / K
Pr = F. A / 1 + A (L / K)
975* t_1^4 - 500 t1 – 7980 = 0
t_1 = 1.768 mm
≈ 2 mm

Similarly
Calculating the Thickness for Link 2 And 3
t_2 = 2.44 mm
And
t_3 = 2.97 mm
Hence We Take Thickness
t = 3 mm
Where,
p = pitch
D = pitch circle diameter of sprocket
α = the pitch angel
α = 360/Z i.e. 360/13= 27.7
Z = number of teeth on sprocket.

Sin α /2 = $\frac{P/2}{D/2}$

The velocity ratio of chain is given by
Where $I = n_1/n_2 = Z_1/Z_2$

DOI: 10.18535/ijecs/v6i6.27

n_1, n_2 = Speeds of driving and driven shafts (R.P.M.)

Z_1, Z_2 = Number of teeth on driving and driven shaft the average velocity of the chain is given by

$$V = \pi \times D \times n/60 \times 10^3$$

$$V = Z \times p \times n/60 \times 10^3$$

V = average velocity in meter/sec.

The length of chain is always expressed in terms of numbers of clanks.

$$L = L_n \times P$$

Where

L = length of chain in mm

L_n = number of link in the chain

The numbers of links in the chain are determined by the following relations

$$L_n = 2(a/p) + (Z_1 + Z_2 / 2) + (Zn- Z_1 / 2x\pi) \times p/a$$

Where,

a = center distance between axis of driving and driven Sprocket.

Z_1 = Number of teeth on Smaller sprocket.

Z_2 = Number of teeth on larger Sprocket.

$$a = P/4\{[Ln - (Z_1 - Z_2 / 2)] + ([Ln - (Z_1 + Z_2 /2)]^2 - 8 [Z_2-Z_1/2X\pi]^2)^{A1}/_2\}$$

2. Design of shaft

The shaft is subjected to fluctuating Loads, so shaft is under combined Bending and Torsion.

Therefore,

The equivalent Twisting Moment.

$$T_e = [(Km \times M)^2 + (K_t \times T)^2]^{1/2}$$

The equivalent Bending Moment.

$$M_e = ½ [K_m \times M + \{(K_m \times m)^2 + (K_t X T)^2\}^{1/2}]$$

Where,

K_m = Combined Shock and Fatigue factor for bending.

K_t = Combined Shock and Fatigue factor for torsion.

For Rotating Shaft

Table. 1 Selection of Nature of Load

Nature of load	Km	Kt
Gradually Applied Load	1.5	1.0
Suddenly applied load with minor shock	1.5 to 2.0	1.5 to 2.0
Suddenly applied load with Major Shock	2.0 to 3.0	1.5 to 3.0

So we consider the load on chain drive maximum 15kg.

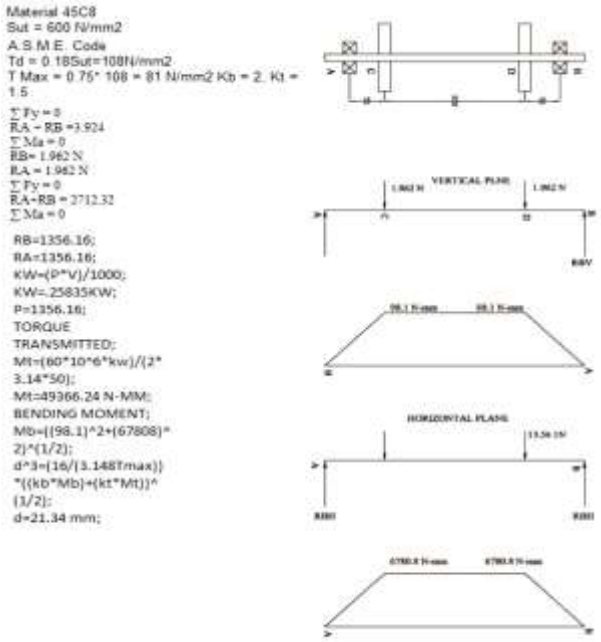

Fig. 1. Stress Analysis of Shaft

3. Selection of Bearing

As load acting on bearing consist of two components Radial & Thrust. So we have used single row deep groove bearing. This bearing has high load carrying capacity & suitable for high running speed.

Table 2. Selection of Bearing

Principle Dimension			Basic load rating in N		Designation
D	D	B	C	Co	
17	40	12	9560	4500	6202

Where,

d = Inner diameter of bearing in mm

D = Outer diameter of bearing in mm

B = Axial width of bearing in mm

C = Dynamic load capacity in N

Co = Static load capacity in N

B. Pneumatic Components

Design of Piston Cylinder

1. a) C 7 (UTS – 340 N / mm^2)
   b) C 10 (UTS- 400N/mm^2)

2. Aluminum (UTS -200N/mm^2)

4. Design of Cylinders

DOI: 10.18535/ijecs/v6i6.27

Let D_i be the internal diameter of cylinder, assuming operating pressure = 4 bar

$(142344 \times (D_i)^2 \times 4 \times 105) = 5105$ N

$D_i = 0.0637$ m.

$D_i = 63.7$mm.

We take,

Di = 69.8 mm (From Pneumatic Handbook)

Thickness of cylinder

Material C- 50, yield strength. Sy = 340 N/sq. m.

Considering cylinder as thick cylinder.

Using CLAVARINO'S EQUATION,

$$T = \frac{Di}{2} * \frac{\sigma + Pi\,(1 - 2\mu)}{16 - Pi(1 + \mu)}$$

$$T = 34.9 * \frac{\sigma + 0.8\,(1 - 0.6)}{16 - 0.8\,(1 + 0.3)}$$

T = 1.38 mm

By practical considerations, we take thickness of cylinder as, T=3mm.

5. Design of Piston

Dia. of piston = I.D. of cylinder

= 69.85 mm

Considering the effective sealing and guiding the piston rod inside the cylinder, we take length of piston in contact with cylinder = 0.32 times diameter of the piston.

The length of step of Dia. 31.7 is taken equal to 12.5 , considering the size of " U" --- cup seal . Piston material is GOI 30 as its grains are small and soft. This helps in reducing wear of the cylinder and provides easy sliding it.

6. Design of Piston Rod

We design the piston rod for bucking .consider the condition fixed at both ends for piston rod.

According to Rankine's formula,

$$Wcr = \frac{Fc \times A}{1 : at\ L/K}$$

Where,

Wcr = Crippling load.

Fc = Crushing stress = 320 N/ m^2

A = Fc / (3.142 x 3.142) x E. Rankine's constant

= 1/ 7500 for M.S.

L = Equivalent length of column

= ½ for both ends fixed (by using Euler's theory)

= Least radius of gyration.

Thus putting the values in the above formula, we have

$$5105 = \frac{320 \times (3.142/4) \times D \times D}{1 + 1/75010\,[1/15 \times (4/D)^2]}$$

$$5105 = \frac{251.2 \times D}{D\,4 + 48.68}$$

Solving further we get,

$D4 - 20.32\,D - 988.52 = 0$

D = 6.58

Considering the impact load coming on the piston rod , we take the diameter of piston rod as ,

D = 19.74 mm.

D = 20 mm.

(Applying a F.O.S. of 4/3)

T.D.C. – B.D.C.

= 135-85

= 50mm

Volume of air exhaust from piston and cylinder: - Stroke x Area of Piston.

= 50 x 4x d2 x L

= 141370mm 3

Volume of tank: - L = 250

D = 100

= n/4 x 100^2 x 250

= 1963.5 x 10^3 mm3

Time required filling the air tank: - Volume of tank / Volume of Piston Exhaust

= 1963.5x10^3/141370

= 14 Sec

Torque required overcoming friction: - F x r

= 6 x10/2

T = 30 N-mm

VII. MANUFACTURING OF COMPONENTS

Part Name: - Shaft

Part size : - 2 8x 650mm

Part WT : - 8 kg

Part Qty : - 2

Part Material M.S.

Table 3. Selection of Machine and Tool for Shaft

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as required size	Power Hack m/c	Hacksaw Blade	10 min
2	Make a turning the material both side make a dia. of 20mm.	Lathe m/c	Turing Tool	10 min

Part Name: - Bearing Plate

Part size : - 60 x 10mm x60mm

Part Qty : - 4

Part Wt : - 6kg

Table 4. Selection of Machine and Tool for Bearing Plate

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as required size	Power Hack m/c	Hacksaw Blade	10 min

2	As in one side after 10mm distance 41mm dia	Lathe m/c	Drilling Bit 20./41mm	15min
3	Facing the Both side	Lathe m/c	Turing Tool	15 min

Part Name :- Bush
Part size :- 35 x 15 mm
Part Qty :- 1 1kg
Part Wt 6 :- M.S.

Table 5. Selection of Machine and Tool for Bush

Sr. No.	Operation	Machine	Tool	Time
1	Cutting the material as required size	Power Hack m/c	Hacksaw Blade	10 min
2	As in center 23 mm hole	Lathe m/c	Turing Tool	10 min

Fig. 2 Compressed air vehicle (assembled prototype)

VIII. ADVANTAGES

1. Easy Construction.
2. Easy manufacturing.
3. Economical
4. Can be built up to various capacities easily.
5. Low maintenance cost

IX. DISADVANTAGES

1. Large storage space is required for the air receiver.
2. Necessity of compressor.

X. CONCLUSIONS

While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose.

The design criterions imposed challenging problems which were overcome by us using good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of wear and tear.

Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the project model to our entire satisfaction.

XI. FUTURE SCOPE

Pneumatic vehicles can be used for public transportation if capacity is improved. They can replace forklifts in industrial area. They can be used for storage of raw material and the same raw material can be transported.

For pneumatic vehicles there are lots of scopes to modify the performance, features and design. As we know the load carrying capacity and speed of pneumatic system is less due to low torque developed at low pressure. So the size of the receiver tank should be increased.

Low speed of the vehicle can be overcome by using solenoid valve with reset timer. Using this vehicle can work continuously. Low storage space can be overcome by using low weight metal with high tensile strength. So the efficiency will be improved

REFERENCES

1. Anirudh Addala & Srinivasu Gangada, *Fabrication and Testing of Compressed Air Car*, Global Journal of Researches in Engineering Mechanical and Mechanics Engineering, Viswanadha Institute of Technology and Management, Year 2013, Volume 13 Issue 1 Version 1.0.
2. A.A.Keste, S. B. Vise,A. N. Adik, P. R. Borase, *Vehicle Operating on Compressed Air by Inversion of Slider Crank Mechanism*, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Department of Mechanical Enginnering, M.E.S. College of Engineerign, Pune, Maharashtra, India, ISSN(e): 2278-1684, ISSN(p): 2320-334X, PP: 50-54.
3. Mr. N. Govind, Mr. S. Sanyasi Rao, Mr. Manish Kumar Behera, *Design and Fabrication of Compressed Air Vehicle*, International journal and Magazine of Enginnering, Technology, Management and Research (IJMETMR), Assistant Professor, Department of Mechanical Engineering, VITS College of engineering, Sontyam, Anandapuram, Vizag, July 2015, ISSN No.: 2348-4845.
4. S. S. Verma, *Latest Developments of A Compressed Air Vehicle*, Global Journal of Researches in Engineering Mechanical and Mechanics Engineering, S.L.I.E.T., Longowal, Year 2013, Volume 13 Issue 1 Version 1.0.
5. Shengzhi Chen, Chongho Youn, Toshiharu Kagawa, Maolin Cai, *Transmission and Consumption of Air Power in Pneumatic System*, Energy and Power Engineering (EPE), Department of Mechano-Micro Engineering, Tokyo Institute of Technology, Kanagawa, Japan, November 2014, 487-495.
6. Rahul Jeughale, Sunil Regude, Swapnil Pathak , Tushar Bagul, *Design and fabrication of Automatic Pneumatic*

Vehicle, International Research Journal of Engineering and Technology (IRJET), U. G. Student, Department of Mechanical Engineering, Anantrao Pawar College of Engineering and Research, Pune, Maharashtra, India, March 2017, Volume: 4, Issue: 3, e-ISSN: 2395-0056, p-ISSN: 2395-0072.

7. P.K.Jadhao , K.K. Jadhao, S. S. Bhagwat, *Design, Modeling and Analysis of Double Acting Reciprocating Compressor Components*, International Journal of Scientific & Engineering Research, April 2012, Volume 3, Issue 4, ISSN 2229-5518.
8. Rakesh P. Shende, Surbhi A. Tode, Dr. R. U. Sambhe, *Design and Fabrication of Pneumatic Vehicle*, International Journal For Engineering Applications and Technology (ITFEAT), Mechanical Engineering Department, J.D.I.E.T. Yavatmal, Maharashtra, India, ISSN: 2321-8134.
9. Prof. V. B. Bhandari, Tata Mc .Graw Hill Publishing Co. New Delhi, Design of machine Elements.
10. Prof . Khurmi , J.K.Gupta, Machine Design.
11. Hajara Chaudhari , Workshop Technology.
12. PSG, Design Data Book.