DESIGN AND DEVELOPMENT OF ENERGY CONVERSION FROM WHEEL

[1] Muksad L. Mulla, [2]Amit V. Patil, [3]Nitish D. Mane, [4]Akshay A. Nangare, [5]Dhanaji M. Patil
Department of Mechanical Engineering, NMCOE Peth, Sangli, India.

Abstract: As we know that Pneumatic energy is the readily available and low cost energy. Nonconventional energy system is very essential at this time to the world. So In this paper, compressed air was produced with the help of Pneumatic cylinder and single slider mechanism. Train and automobile passenger door is the key system for operation and maintenance on urban rail train and automobile. In this paper, we analysis passenger door system of urban rail train working process and establish working model. Firstly, we used the method of parameters estimation to get physical parameter of door on different working condition. Today energy conservation is the need of every industry, transportation field. So we have taken challenge to make project in this automobile and train field to support energy conservation system. Using rotating wheel energy is used for getting positive outcomes of project. By this outcome we are producing a compressed air in storage tank. This Compressed air is utilizing for opening & closing the Door- Windows of the train and automobile vehicles. It can be also used for AC system & refrigeration system by using pulse tube mechanism to store the food like fish, vegetable etc. It can also use to clean the train, cooling the radiator of engine.

Index Terms **- Door control system, Fault diagnosis, Principal component analysis (PCA).**

I. INTRODUCTION

Pneumatic systems form the most primitive and distinct class of mechanical control engineering. They are classified under the term 'fluid power control', which describes any process or device that converts, transmits, distributes or controls power through the use of pressurized gas or liquid. All fluids have the ability to translate and transfigure and hence pneumatic systems permit variety of power conversion with minimal mechanical hardware. 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 these features make them versatile and find universal applications including robotics, aerospace technology, production and assembly of automotive components (power steering, chassis and engine assembly), CNC machines, food products and packaging industry and fabrication process of plastic products. A mechanism is a simplified model, usually in the form of a line diagram, which is used to reproduce the motion occurring in a machine. The purpose of this reproduction is to enable the nature of the machine.

The purpose of this reproduction is to enable the nature of the motion to be investigated without the encumbrance of the various solid bodies which form the machine elements the various parts of the mechanism are called links or elements. Where two links are in contact and a relative motion is possible, then they are known as a pair. An arbitrary set of a links which form a closed chain that is capable of relative motion, and that can be made into a rigid structure by the addition of a single link, is known as a kinematics chain.

To form a mechanism from a kinematics chain one of the links must be fixed. However as any of the links can be fixed, it follows that there are as many mechanism as there are links in the chain. The technique obtaining different mechanism by fixing the various links in turn is known as inversion. Today energy conversion is the need of every industry, transportation field. So we have taken challenge to make project in this automobile & train field to support energy conservation system.

As we all Know that energy conservation is the need of hour. Energy conversion using wheel is totally new concept. So keeping the above facts in mind we choose these topics to prepare our working model.

II. LITERATURE SURVEY

Wonkyong Kim et all : There are many EMU lines in Korea but only one type has been applied to passenger side door. This type is so called "Pocket sliding type". This type has some week points. To begin with, it is not good for decreasing the noisy from the outside of car body. And the second time, if some obstacles are put between sliding door, only driver can operate re-open door switch manually in driver's cab. This type is so dangerous for passengers. So many people want to the new door type that have no defect. KRRI joined forces with ANT corporation for pneumatic plug door system. This type will be good for decreasing the noisy, passenger's safe. The project was started at the last year on November and finished on June, this year. In this paper, we will deal with the role of cylinder, complex planetary gear, door control unit, dynamic mechanism, and the report of FEM, type test. This paper will contribute to the electric motor control plug door system.

Saurabh Shakya et all: Indian Railways is India's national railway system. Operated by the Ministry of Railways, IR carried 8.107 billion passengers (more than 22 million passengers per day), transported 1.101 billion tons of freight, and had 8,500 stations in the 2015-16 fiscal year. It is the fourth-largest railway network in the world bysize,with119,630 kilometers (74,330mi) of total track and 92,081 km (57,216 mi) of running track over a 66,687- kilometer (41,437mi) route at the end of 2015-16. Forty-five per cent of its routes are electrified with 25 kV AC electric traction. Its track is mostly broad gauge, with short stretches of meter- and narrow-gauge track. Thirty- seven percent of its routes are double-or multi-tracked. IR operates long-distance and suburban rail systems, and ran an average of 13,313 passenger trains daily in 2015-16.The trains have a five-digit numbering system. Mail or express trains, the most common types, run at an average speed of 50.9 kilometers per hour (31.6mph). At the end of 2015-16, IR's rolling stock consisted of 254,006 freight wagons,70,241 passenger coaches and 11,122 locomotives (39 powered by steam, 5,869 by diesel fuel and 5,214 by electricity). IR owns locomotive- and coach-production facilities at several locations in India. The world's eighth- largest employer, it had 1.33143 million employees at the end of 2015-16. IR had earnings of ₹1.683 trillion (US$26 billion) in 2015–2016, consisting of ₹1.069 trillion (US$17 billion) in freight revenue and ₹442.83

billion (US$6.9 billion) in passenger revenue, and an operating ratio of 90.5 per cent in 2015-16. IR's Research Design and Standards organization (RDSO) undertake research, design and standardization. The railway has undertaken several initiatives to upgrade its ageing infrastructure and improve its quality of service. The Indian government plans to invest ₹9.05 trillion (US$140billion) to upgrade IR by 2020. Hence we decided to take challenge to make project in this Train field to support energy conservation.

Krushna. S. Rajput et all: Train passenger door is the key system for operation and maintenance on urban rail train. In this paper, we analysis passenger door system of urban rail train working process and establish working model. Firstly, we used the method of parameters estimation to get physical parameter of door on different working condition. Today energy conservation is the need of every industry, transportation field. So we have taken challenge to make project in this Train field to support energy conservation system. Using rotating wheel energy is used for getting positive outcomes of project. Compressed air is utilizing for opening & closing the Door- Windows of the train. It can be also used for AC system & refrigeration system by using pulse tube mechanism to store the food like fish, vegetable etc. Compressed air is used for Supporting Breaking system in emergency, by arranging many piston &cylinder in large capacity. It can also used to clean the train, cooling the radiator of engine. It is used for generation of electricity with the help of turbine mechanism to operate lighting, Horn, etc.

Suresh D. Mane et all: Two major railway coach repair workshops involved in periodical overhauling of broad gauge passenger coaches located in south India has been undertaken for studying the drivers for energy conservation (EC). The study covers a period of six calendar years from 2007 to 2012 and takes into account the various activities in terms of maintenance of coaches and production of components. The result analysis finds show the similar first three ranking in both the workshops with total weighted average of greater than 0.5. The driver “awareness and adoption of latest technologies for EC” is a close second with a weighted average of 0.16 and 0.17 respectively from MYSS and UBLS respectively. Capacity utilization is ranked third which again is common for both the workshops. This clearly indicates that railways is mainly driven by the dedication of its personnel and its sustenance and improvements on the energy front continue to contribute mainly by them.

Lin Shuai et all: Train passenger door is the key system for operation and maintenance on urban rail train. In this paper, we analysis passenger door system of urban rail train working process and establish them at hematical model. Firstly, we use the method of parameter estimation to get physical parameters of doors on different working condition. Then fault diagnosis experiment is done to train passenger door with principal component analysis and rough set theory. In the end, we verify fault diagnose accuracies under different time settings of opening and closing profile with the test rig.

Bhoye Anil Dharmaraj et all: Locomotive is any type of self-propelled vehicle used by railroad to pull or push other type of rolling stock, including passengers, freight. An India is an extensive country. Now day’s railway playing a vital role in transport of freight and passengers. Trains are the veins of are country. Indian railway network is one of the largest railway network in the world. Today the growth is phenomenal and the network have a route length of 62,458 Km, with 7116 station. It has fleet of 8268 locomotive 29,501 Coaches, 3291 Electronic multiple units & 3, 46,394 wagons. Today energy conservation is the need of every industry, transportation field. So we have taken challenge to make project in this Train field to support energy conservation system. It has been a great experience while competing our project we come across lot of many practical knowledge as well as experience. We had an opportunity to learn how project are been done. We received a lot of practical experience while working on this project as well as got enough freedom to our ideas for the improvement in our assigned project and check whether ideas are fruitful. While designing Train wheel operated compressor it was kept in mind that this machine is being manufactured only once. Therefore the design must be as perfect as possible and special attention is given during each manufacturing activity. We paid special attention during each & every manufacturing process that was carried out. In the manufacturing we come to know how theoretical aspects are implemented in actual practice, we got to learn about different manufacturing processes, welding, gear, cutting etc. We are really please to see our Train wheel operated composer for various system working successfully.

As a step toward gaining a better understanding of the construct of spiritual intelligence, this study was designed to analyze whether the spiritual intelligence self report inventory (sisri) originally developed and validated in canada by king (2008) is a valid measure of spiritual intelligence in the Indian scenario. The study investigates the construct validity of the instrument by examining the dimensions proposed to explain the interrelations among items included in the instrument, and by examining the relationship between spiritual intelligence of the individuals measured using the scale and their work performance.

III. CONSTRUCTION & DESIGN

The construction of wheel operated Pneumatic System is very simple & compact. Basically it is assembly of Base frame Wheel, Piston-Cylinder, and Air reservoir to analyze whether SISRI is a valid measure of spiritual intelligence in the Indian scenario.

3.1 Base frame

Base frame is made of Fabrication angle. Supported angles are joint under base frame, where the motor & valve is located. Then piston supporter is mounted. **Use**: The use of the base frame is to give Support & Stability to all project components.

Table 1 Required. Material

MATERIAL	MATERIALSIZE	WEIGHT	QUANTITY
Cast Iron	600mm X300mm	2kg	1

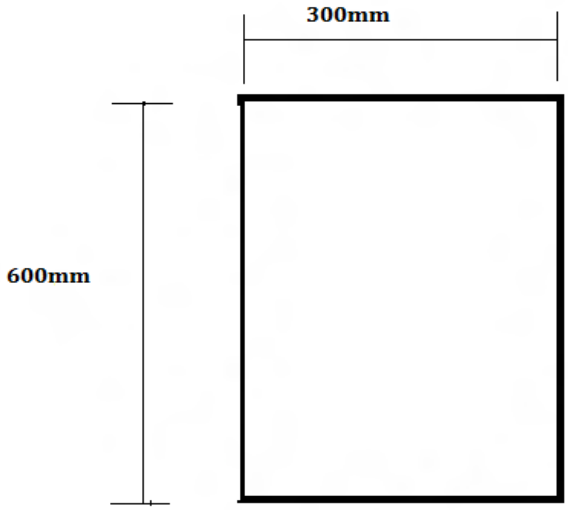

Figure 1: Base Frame

3.2 Air Reservoir:

Air tank is made of Mild steel. A hole is drilled at the upper side & threading is done to keep the pressure gauge, then fix two ends using welding & make an input & output air connection.

Use: - To store pressurize compressed air & supply this pressurize air for various use when required.

Table 2 Material required.

MATERIAL	MATERIALSIZE	WEIGHT	QUANTITY
Mild Steel	150mm X 200mm	3kg	1

Figure 2: Air Reservoir

Calculation for Reservoir Tank:

Volume of tank = $\pi x r^2 x h$

(h = 200mm, D =150mm, r = 75 mm)

$= \pi \text{ x } 75^2 \text{ x } 200$

$= 3.53 \text{ x } 10^6 \text{ mm}^3$

No. of strokes required filling the air tank: -

= Volume of tank / Volume of Piston Exhaust

$= 3.53 \text{ x} 10^6 / 2.3 \text{ x } 10^4$

$= 153.47 \approx 154$ **Stroke**

3.3 Air Piston Utiliser:

Air Piston utiliser is fitted on frame by using the nut & bolts, at the backside of door. This Air piston utiliser is run by pressurize air that come from lever control valve, which is used to control air, come from Air tank. **Use: -**To operate door, windows.

Table 3 Material required.

MATERIALSIZE	QUANTITY
Ø 20 X 75mm	2

Calculation for cylinder:

Volume for one stroke =$\pi\ x\ r^2\ x\ h$

(h = 75 mm, r = 10 mm)

$= \pi \times 10^2 \times 75$

$=2.3 \times 10^4\ mm^3$

Figure 3: Air Piston Utiliser

3.4 Door:-

The door is opened & closed on the base frame at the Centre. A piston connection is given at the backside of the door due to which the door moves in both directions. **Use:-** For comfort entry & exit to public.

Weight Calculation of door:

$$Area(A) = L \times W$$

Area = 250mm × 150mm

$=37500\ mm^2$

$$Volume\ (V) = L \times W \times T$$

$= 250\ mm \times 150\ mm \times 2mm$

$V=75000\ mm^3$

$$Weight = V \times \rho$$

$= 75000 \times 7850 = 588750000 \times 10^{-9}$

$= 0.5887\ kg$

3.5 Wheel:-

Then rolling shaft is attached at the center line of wheel & connecting rod is fixed at the periphery of wheel.

Use: -To give power and Rotary motion to Connection rod.

3.6 Motor:-

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy.

Figure 4:- Gear Motor

Motor specification-

Single Phase, 240 Volts, 50 Hz, 0.5 HP

Speed : - 100 rpm,

Type : - Gear motor

3.7 Shaft Selection:-

PART NAME	: ROLLING SHAFT.
MATERIAL SIZE	: 16mm X 340mm
MATERIAL	: Mild Steel
WEIGHT	: 1Kg.

3.8 Air circulating devices:

The compressed air is stored in an air receiver from which air is drawn out into the consumer point by means of pipe line. While laying out the pipe line for the system, one should take sufficient care and pay attention to see that the pressure drop from the generating point to the point of consumption remains as low as possible. For economical reason, it is always better if the total drop

of pressure is kept limited to a maximum value of 0.1 bar or even less. The following factors are taken into account while selecting pneumatic pipeline and other air- line installations:-

- Pressure of compressed air in the lines.
- Total flow rate per unit time through the line.
- Permissible pressure drop in the line.
- Types of tube material and types of line fitting.
- Length and diameter of tube or other pipelines.
- Working environment.

Considered the above factors we have selected the flexible hose tubes of 1/8"diameter.

3.9. Flow control valve:

Figure 5:- Flow control valve

Flow control valve regulates the flow or pressure of a fluid. Control valves normally respond to signals generated by independent devices such as flow meters or temperature gauges. Control valves can also work with hydraulic actuators (also known as hydraulic pilots). These types of valves are also known as Automatic Control Valves. The hydraulic actuators will respond to changes of pressure or flow and will open/close the valve. Automatic Control Valves do not require an external power source, meaning that the fluid pressure is enough to open and close the valve..Automatic control valves include: pressure reducing valves, flow control valves, back-pressure sustaining valves, altitude valves, and relief valves. An altitude valve controls the level of a tank. The altitude valve will remain open while the tank is not full and it will close when the tanks reaches its maximum level. The opening and closing of the valve requires no external power source (electric, pneumatic, or man power).

3.10. DCV 5/2 Hand Lever Operated:

Use:-Valve deliver compressed air to a small air cylinder inside valve. The compressed air in this cylinder pushes against the piston and actuates the solenoid to switch the valve**.**

3.10.1 Working of 5/2 valve:

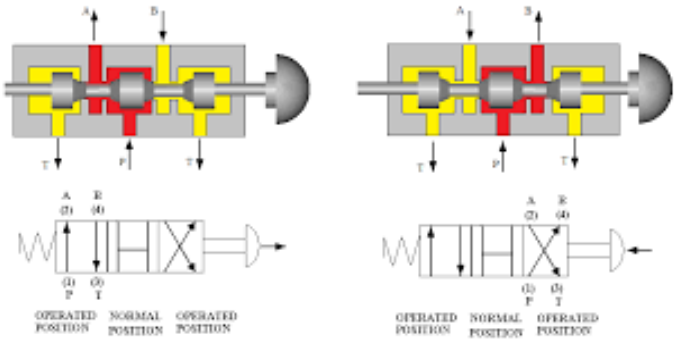

Figure 6: 5/2 DCV Principal

A valve is a device that regulates the flow of fluid (gases, liquids, fluidized solids, or slurries) by opening and closing or partially obstructing passage ways. A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be use to isolate and simultaneously bypass a passage way for the fluid which for example should retract or extend a double acting cylinder.

Figure 7: 5/2 DCV Hand Lever

IV. PRINCIPAL OF PNEUMATIC SYSTEM:

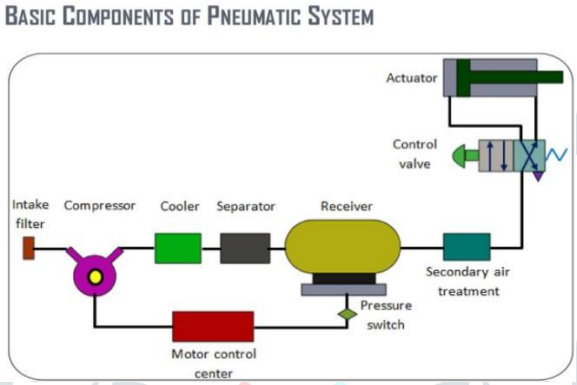

Figure 8: Principal of pneumatic system

4.1 Introduction:-

Pneumatic systems form the most primitive and distinct class of mechanical control engineering. They are classified under the term 'Fluid Power Control', which describes any process or device that converts, transmits, distributes or controls power through the use of pressurized gas or liquid. 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. Pneumatic systems are well suited for the automation of a simple repetitive task. The working fluid is abundant in nature and hence the running and maintenance cost of these systems are exceptionally low. All fluids have the ability to translate and transfigure and hence pneumatic systems permit variety of power conversion with minimal mechanical hardware.

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. These features make them versatile and find universal applications including robotics, aerospace technology, production and assembly of automotive components (power steering, chassis and engine assembly), CNC machines, food products and packaging industry, bomb deployment units and fabrication process of plastic products.

4.1.1 History of Pneumatic system:

For thousands of years, man has used air as an aid in doing various tasks, e.g. a bellows for lighting fires. In the year 260 BC, a Greek called Ctesibios built the first air gun. In addition to a tight sinew, he used air compressed in a cylinder to increase the range of projectiles. So it is not surprising that "pneuma", the Greek word for "air", has given its name to the technology known as pneumatics. During the industrialization process in the 19th century, machines powered by compressed air were used for mining and building roads. Pneumatic technology has become indispensable in modern industry. Pneumatically powered machines and robots are to be found in numerous industrial processes such as assembling or arranging components, or packing finished goods.

V. TRANSMISSION SYSTEM:-

The rotary motion of the motor is transmitted to the operative element to provide an operative working or auxiliary motion. When the required motion is rotary; the transmission takes place through mechanisms that transfer Rotary motion from one shaft to another.

Transmission of the motion from the external source to the operative element can take place through Mechanical elements such as belts, Gears, chains etc. Mechanical Transmission and its elements: -

i. Belt Transmission
ii. Gear Transmission
iii. Chain Transmission

Belt Transmission: -

Belt drive is one of the most common effective devices transmitting motion and power from one shaft to the other by means of thin inextensible belt over running over to pulleys. This largely used for general purpose on mills and factories especially when the distance between the Shafts is not very great.

When the center distance between the two shafts is large than the tight side of the belt should be the lower one the pulley called driver is mounted on the driving shaft while the shaft while the other, which is mounted on the shaft to which power is to be transmitted is called the driven pulley or follower.

Gear Transmission: -

Efficiency of power transmission in belt and rope drives is less. The power may be transmitted from one shaft another by means of mating gears with high transmission Efficiency and a gear drive is also provide when the between driver and follower is very small.

Chain Transmission

Chains are used for high transmission number. They are mostly used when distance between center is short but the center distance is as much as 8m. They are now generally used for transmission of power in cycle, motor vehicle, and agriculture machinery in workshops. It is general requirement for any machines that they should provision for regulating speed of travel. The regulation may be available in discrete steps or it may be steeples i.e. continuous. The format are known as stepped drives Ex. Lathe machine, milling machine, printing machine etc.

VI. ENERGY CONVERSION:-

Energy is the fundamental need of our everyday life. So much so, that the quality of life and even its sustenance, is dependent on the availability of energy. Hence, it is imperative for us to have a conceptual understanding of the various sources of energy, the conversion of energy from one form to another and the implications of these conversions. You must have heard that heard that Energy conversion from one form to another is a well-known phenomenon.

Energy Conversion is defined as the process where there is a change in energy from one form to another such as the conversion of nuclear energy into heat energy, the conversion of light energy into heat, thermal energy into work etc. Some examples of energy conversion are:

- A vehicle moving is an example of chemical energy being converted into kinetic energy.
- Electricity being produced with water is an example of potential energy being converted into kinetic energy.
- A ball from a height towards the ground is an example of potential energy being converted into kinetic energy.
- When you boil water using an electric kettle, it's an example of electric energy being converted into heat energy.
- These were some of the modern examples of energy conversion. Now, let's take a look at how the energy conversion technology has evolved over the years and how the early humans used energy conversion by harnessing the natural forms of energy.

6.1 Types of Energy Conversions:-

- Light energy can be converted to heat energy.
- Electrical energy can be converted to mechanical energy, light energy, heat energy etc.
- Chemical energy can be converted to electrical energy.
- Thermal energy can be converted to heat energy.
- Mechanical energy can be converted to electrical energy, potential energy, etc.

6.2 Application:-

- Compressed air is utilizing for opening & closing the Door- Windows of the train.
- It can be also used for AC system & refrigeration system by using pulse tube mechanism to store the food like fish, vegetable etc.
- Compressed air is used for Supporting Breaking system in emergency, by arranging many piston & cylinder in large capacity.
- It can also used to clean the train, cooling the radiator of engine.
- It is used for generation of electricity with the help of turbine mechanism to operate lighting, Horn, etc.

6.3 Advantages of Compressed Air Pneumatic Systems:

- Freely available from the atmosphere.
- Explosive proof. No protection against explosion required.
- Easily transportable in the vessels and pipes.
- No return lines are required. Clean system.
- It has self-cleaning properties. Simple construction and ease of handling.
- Unduplicated exhaust clear air which escapes through leaking pipe or components don't cause contamination.
- The pressure, speed and forces required can be controlled easily.
- Overload safety pneumatic tools and operating components can be loaded to the point of stopping and are therefore overload safe.
- Air enables high working speed to be obtained, low cost of maintenance.

6.4 Disadvantages of Compressed Air System:

- It is inaccurate in operation.
- High forces cannot be transmitted.
- It provides non-uniform speeds
- Creates noise pollution.
- Expensive.
- Conditioning of air is needed.

VII. DESIGN

In our attempt to design a pneumatic train we have adopted a very careful approach. Total design work has been divided into two parts mainly,

1. System Design
2. Mechanical Design

System design mainly concern with the various physical concerns and ergonomics, space requirements, arrangements of various components on the main frame of machine, number of controls, positions of this controls, ease of maintenance, scope of further improvements, height of machine components from the ground etc. In mechanical design, the components are categorized into two parts.

1. Design Parts
2. Parts to be purchased

7.1 Construction of Chain

The pin is press fitted to two outer link plates while the bush is press to inner link plates. The bush and the pin form a swivel joint and the outer link are freely fitted on bushes and during engagement, turn with the teeth of the sprocket wheels. This result is rolling friction instead of sliding friction between the roller and sprocket teeth and reduces wear. The pins bushes and rollers are made of alloy Steel.

Usually in automobile 08b (ISO chain number) is used the their dimensions are as follow

Table No. 4

ISO chain	Pitch P	Roller diameter D1	Width B1	Breaking load for Single stand chain
08 B	12.70	8.51	7.75	18.2

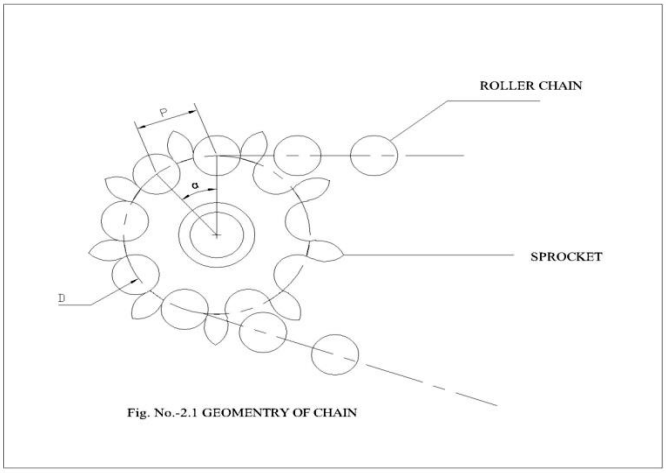

Figure 9: Geometry of chain

7.2 Design of shaft

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

Therefore,

The equivalent Twisting Moment.

$$Te = [(km \times M)\,2 + (kt \times T)\,2]\,l/2$$

The equivalent Bending Moment.

$$Me = ½\,[km \times M + \{(km\,x\,m)\,2 + (kt\,X\,T)\,2\}\,l/2]$$

Where,

Km = Combined Shock and Fatigue factor for bending.

Kt = Combined Shock and Fatigue factor for torsion.

Table No. 5

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

7.3 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 No. 6

Principle Dimension			Basic load rating in N		Designation
d	D	B	C	Co	
10	26	10	9560	4500	6000

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

Stroke : - T.D.C. – B.D.C.

= 135mm – 85mm

= **50 mm**

Volume of air exhaust from piston and cylinder :-

= Stroke X Area of Piston.

= 50 x 4 x d2 x L

= **141370 mm^3**

Volume of tank: -

L = 250

D =100

=n/4 x 1002 x 250

= **1963.5 x 103 mm^3**

Time required filling the air tank :-

=Volume of tank / Volume of Piston Exhaust

= 1963.5x103/141370

= **14 min**

Torque required to overcome friction :-

= F x r

= 6 x 10/2

T= 30N- MM

Speed of the shaft : -

= Tangential speed x 60/Circumference

= 22.5x60/3.14x35

N= 12.28 rpm

Required Torque : -

= 2nNT/60

= 2n x 12.28 x 30/60

W = 38.56N-mm

Motor : - should has greater than 38.56 watts.

1HP = 739 Watts.

From this equation for 38.56 watts, **0.008 HP motor is required**

Speed : - 100 rpm,

Type : - Gear motor.

Pressure gauge = 4.2Kg/cm2

VIII. WORKING:

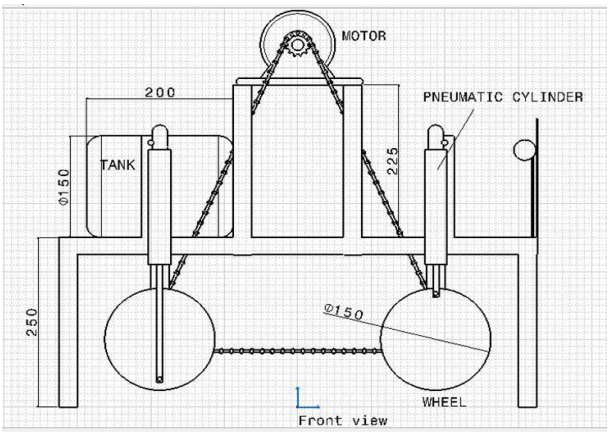

Figure 10: Working of Model

The wheel operated compressor for various systems is work on law of energy conservation. The law states that "energy neither can be created nor destroy but it may transform from one form of energy to another, so sum of energy in its various forms remains constant in the universe."

When the wheel starts moving, the wheel starts rotating. The connecting rod that is fixed on the periphery of the wheel also starts to rotate with wheel. This rotary motion is further converted in to reciprocating motion with the help of piston cylinder arrangement that is connected at the other end of the connecting rod.

When piston start reciprocating in the cylinder creates suction as it moves towards (B.D.C.) Bottom dead Centre, air enter in the cylinder from one hole which is provided with a Non Return Valve (N.R.V.) & when the piston moves towards Top Dead Center (T.D.C.), it compresses the air and this operation is continuous and discharge is obtained in air reservoir tank.
When we operate lever control valve, air come from air reservoir tank to Air piston utiliser. This Pressurize air push & Pull to the piston in reciprocating motion causes the opening & closing of the door.

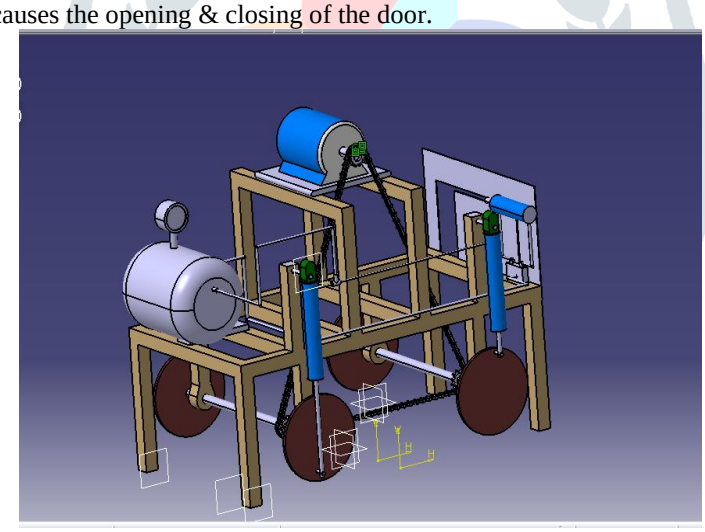

Figure 11: Expected Project Model

IX. OBSERVATION

Time required for fill complete tank: 39 sec

To achieve 1 bar pressure in reservoir tank: 130 sec To achieve 1.5 bar pressure in reservoir tank: 300 sec

For door weight 480 gm

Required force for opening & closing the door Force = Pressure x area of pneumatic cylinder Pressure (P) = 0.15bar

Area of pneumatic cylinder = $\pi \times r^2$

(r = 10mm)

$= \pi \times (102)$

$= \mathbf{314.15\ mm^2}$

F = 0.015 x 314.15

= 4.71N

= 4.71/9.81

= 0.48 kg (480gm)

System Comparison with Bus Door system:

For door weight 35kg

For our system door weight 480gm it's required pressure 0.15bar Bus door weight is 35kg (35000gm)

Comparing both systems we have,
480 = 0.15
35000 = P (pressure)
We have calculated result is, 480 x P = 35000x0.15
P = 5250/480
P= 10.93 bar

X. PROJECT OUTCOME:

- Compressed air is utilizing for opening & closing the Door of Automobile Vehicle& Train.
- It will also used for opening & closing the Windows of Automobile Vehicle & Train.
- Also It can be used for cleaning the vehicle & train by using pressurized air store in reservoir tank.
- Also It can be used for cooling purpose in AC system
- It can be used for to store the food like vegetables, fruits etc. in refrigeration system.
- Compressed air is used for emergency breaking system by arranging many piston & cylinder in large capacity.
- It can be also used to cooling the radiator of engine.

REFERENCES

[1] Raghunathan V. et al. "Energy aware wireless microsensor networks". In: *IEEE Signal Processing magazine* **19** (2002), pp. 40-50.

[2] Frank R. "Move over, Bluetooth ; Zigbee is here", *In: Design News* **4** (2004)

[3] Beeby S.P., Tudor M.J. and White N.M., "Energy harvesting vibration sources for Microsystems application", In: *J. Meas. Sci. Technol*. **17** (2006), R175-195.

[4] Roundy S., Wright P.K. and Rabaye J. " A study of low level vibrations as a power source for wire less sensor nodes". *In computer communications* **26** (2003), pp. 1131-1144.

[5] Menon Sreevalsan S., Sooraj M S, Mohan Sanjay, Disney Rino, Sukumaran Suneeth, "Design And Analysis Of Kinetic Energy Recovery System In Bicycles", Vol. 2, **Issue 8,** August 2013, *International Journal of Innovative Research in Science, Engineering and Technology* ISSN: 2319-8753

[6] Patil Sameer. G., Singh Rithwik M, "*Regenerative braking principle by using kinetic energy recovery system-A review*", VOL-2, **ISSUE-2**, 2015. ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697

[7] Boretti Alberto., "*A fun-to-drive, economical and environmentally friendly mobility solution", Journal of power technologies"*, **93** (4) -2013

[8] Cibulka, J. "Kinetic energy recovery system by means of flywheel energy storage", *ADVANCED ENGINEERING*, **3** (2009)1, ISSN 1846-5900.

[9] kumar L N Pavan, H M Dileepraj & M E Dikshith, "Kinetic Energy Recovery System Bicycle", *International Journal of Ignited Minds (IJIMIINDS)*, Volume: 01 **Issue: 09**,Sep-2014.

[10] Patil Siddharth K., "Regenerative Braking System in Automobiles", ISSN: 2249-5762 (Online), IJRMET Vol. 2, **Issue 2**, May - Oct 2012.