International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

AUTOMATIC PNEUMATIC BUMPER IN 4 WHEELER VEHICLE

Asst. Prof. Swapnil Patil ,Suraj Mohite[2], Mahesh Motkar[3] , Omkar Kurlekar[4] , Krushna Raut[5]

[1,2,3,4,5]*Mechanical Engineering, SPPU, Pune, (India)*

ABSTRACT

The technology of pneumatics plays a major role in the field of automation and modern machine shops and space robots. An extendable and retractable bumper (E/R bumper) is presented in this project. The aim is to design and develop a control system based intelligent electronically controlled automotive bumper activation is called AUTOMATIC PNEUMATIC BUMPER SYSTEM . The E/R bumper is intended to automatically extend in situations in which there is a high risk of frontal impact to prepare the vehicle for crash and retract when the risk subsides.

This bumper system is only activated the vehicle speed above 30-40 km per hour. This vehicle speed is sensed by the proximity sensor and this signal is given to the control unit and pneumatic bumper system

I.INTRODUCTION

The structures and interiors of modern motor vehicles are designed to prepare for a crash full time although crashes are relatively rare events. Full time readiness for a crash has imposed stringent restrictions on the styling, design and utility of motor vehicles. With the advancement in sensing technologies, a new class of safety features, called crash preparation features, has shown great potential in relieving the design restrictions. "Crash preparation" is the timely reconfiguration of a vehicle's structure and interior to the crash-ready state before an imminent crash. If the threat of a crash subsides, the vehicle reverts to its normal driving state, i.e., a "less" crash-ready state. Crash preparation can offer the needed crash protection while allowing new styling, design and utility previously not possible due to the needs for crash protection.

II.NEED FOR AUTOMATION

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics form an attractive medium for low cost automation. The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production.

For mass production of the product, the machining operations decide the sequence of machining. The machines designed for producing a particular product are called transfer machines. The components must be moved automatically from the bins to various machines sequentially and the final component can be placed separately

for packaging. Materials can also be repeatedly transferred from the moving conveyors to the work place and vice versa.

Nowadays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

※ To achieve mass production
※ To reduce man power
※ To increase the efficiency of the plant
※ To reduce the work load
※ To reduce the production cost
※ To reduce the production time
※ To reduce the material handling
※ To reduce the fatigue of workers
※ To achieve good product quality

III. SELECTION OF PNEUMATICS

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatics is an attractive medium for low cost mechanization particularly for sequential or repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing both the power or energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).

IV. IR SENSOR

A sensor is a transducer used to make a measurement of a physical variable. Any sensor requires calibration in order to be useful as a measuring device. Calibration is the procedure by which the relationship between the measured variable and the converted output signal is established.

Care should be taken in the choice of sensory devices for particular tasks. The operating characteristics of each device should be closely matched to the task for which it is being utilized. Different sensors can be used in different ways to sense same conditions and the same sensors can be used in different ways to sense different conditions.

In our project IR transmitter and IR receiver are used to detect the obstacle. These sensors are fitted at the front side of the vehicle.

4.1 IR TRANSMITTER:

The IR transmitting circuit is used in many projects. The IR transmitter sends 40 kHz (frequency can be adjusted) carrier under 555 timer control. IR carriers at around 40 kHz carrier frequencies are widely used in TV remote controlling and ICs for receiving these signals are quite easily available.

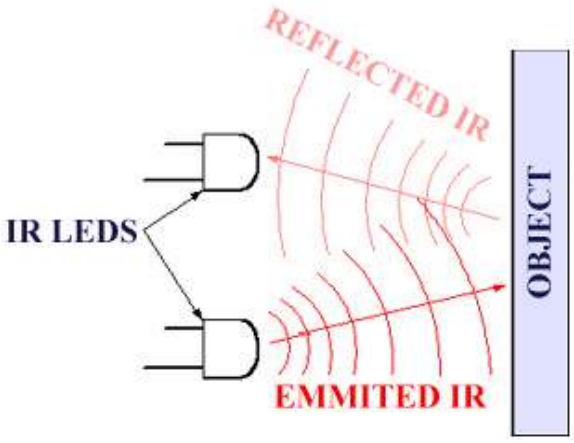


FIG 2. IR SENSOR RAYS

4.2 IR RECEIVER

The transmitted signal reflected by the obstacle and the IR receiver circuit receives the signal and giving control signal to the control unit. The control unit activates the pneumatic breaking system, so that break was applied.

V. COMPONENTS

The pneumatic bearing press consists of the following components to fulfill the requirements of complete operation of the machine.

1) PNEUMATIC SINGLE ACTING CYCLINDER
2) SOLENOID VALVE
3) FLOW CONTROL VALVE
4) WHEEL ARRANGEMENT
5) STAND

1) PNEUMATIC SINGLE ACTING CYLINDER:

Pneumatic cylinder consist of

A) PISTON B) CYLINDER

The cylinder is a Single acting cylinder one, which means that the air pressure operates forward and spring returns backward. The air from the compressor is passed through the regulator which controls the pressure to required amount by adjusting its knob. A pressure gauge is attached to the regulator for showing the line pressure. Then the compressed air is passed through the single acting 3/2 solenoid valve for supplying the air to one side of the cylinder.

One hose take the output of the directional Control (Solenoid) valve and they are attached to one end of the cylinder by means of connectors. One of the outputs from the directional control valve is taken to the flow control valve from taken to the cylinder. The hose is attached to each component of pneumatic system only by connectors.

CYLINDER TECHNICAL DATA:

Piston Rod: M.S. hard Chrome plated

Seals: Nitrile (Buna – N) Elastomer

End Covers: Cast iron graded fine grained from 25mm to 300mm

Piston: Aluminium

Parts of Pneumatic Cylinder

Piston:

The piston is a cylindrical member of certain length which reciprocates inside the cylinder. The diameter of the piston is slightly less than that of the cylinder bore diameter and it is fitted to the top of the piston rod. It is one of the important parts which convert the pressure energy into mechanical power.

The piston is equipped with a ring suitably proportioned and it is relatively soft rubber which is capable of providing good sealing with low friction at the operating pressure. The purpose of piston is to provide means of conveying the pressure of air inside the cylinder to the piston of the oil cylinder.

The piston is single acting spring returned type. The piston moves forward when the high-pressure air is turned from the right side of cylinder.

The piston moves backward when the solenoid valve is in OFF condition. The piston should be as strong and rigid as possible. The efficiency and economy of the machine primarily depends on the working of the piston. It must operate in the cylinder with a minimum of friction and should be able to withstand the high compressor force developed in the cylinder and also the shock load during operation.

Piston Rod

The piston rod is circular in cross section. It connects piston with piston of other cylinder. The piston rod is made of mild steel ground and polished. A high finish is essential on the outer rod surface to minimize wear on the rod seals. The piston rod is connected to the piston by mechanical fastening. The piston and the piston rod can be separated if necessary.

One end of the piston rod is connected to the bottom of the piston. The other end of the piston rod is connected to the other piston rod by means of coupling. The piston transmits the working force to the oil cylinder through the piston rod. The piston rod is designed to withstand the high compressive force. It should avoid bending and withstand shock loads caused by the cutting force. The piston moves inside the rod seal fixed in the bottom cover plate of the cylinder. The sealing arrangements prevent the leakage of air from the bottom of the cylinder while the rod reciprocates through it.

Cylinder Cover Plates

The cylinder should be enclosed to get the applied pressure from the compressor and act on the pinion. The cylinder is thus closed by the cover plates on both the ends such that there is no leakage of air. An inlet port is provided on the top cover plate and an outlet ports on the bottom cover plate. There is also a hole drilled for the movement of the piston.

The cylinder cover plate protects the cylinder from dust and other particle and maintains the same pressure that is taken from the compressor. The flange has to hold the piston in both of its extreme positions. The piston hits the top plat during the return stroke and hits the bottom plate during end of forward stroke. So the cover plates must be strong enough to withstand the load.

2. SOLENOID VALVE WITH CONTROL UNIT:

The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV, this valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts.

This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically. The pull type solenoid is one is which the plunger is pulled when the solenoid is energized.

The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.

- *Parts of a Solenoid Valve*

1. Coil

The solenoid coil is made of copper wire. The layers of wire are separated by insulating layer. The entire solenoid coil is covered with an varnish that is not affected by solvents, moisture, cutting oil or often fluids. Coils are rated in various voltages such as 115 volts AC, 230 volts AC, 460 volts AC, 575 Volts AC, 6 Volts DC, 12 Volts DC, 24 Volts DC, 115 Volts DC & 230 Volts DC. They are designed for such frequencies as 50 Hz to 60 Hz.

2. Frame

The solenoid frame serves several purposes. Since it is made of laminated sheets, it is magnetized when the current passes through the coil. The magnetized coil attracts the metal plunger to move. The frame has provisions for attaching the mounting. They are usually bolted or welded to the frame. The frame has provisions for receivers, the plunger. The wear strips are mounted to the solenoid frame, and are made of materials such as metal or impregnated less fiber cloth.

3. Solenoid Plunger

The Solenoid plunger is the mover mechanism of the solenoid. The plunger is made of steel laminations which are riveted together under high pressure, so that there will be no movement of the lamination with respect to one another. At the top of the plunger a pin hole is placed for making a connection to some device. The solenoid plunger is moved by a magnetic force in one direction and is usually returned by spring action. Solenoid operated valves are usually provided with cover over either the solenoid or the entire valve. This protects the solenoid from dirt and other foreign matter, and protects the actuator. In many applications it is necessary to use explosion proof solenoids.

3. FLOW CONTROL VALVE:

This valve is used to speed up the piston movement and also it acts as an one – way restriction valve which means that the air can pass through only one way and it can't return back. By using this valve the time consumption is reduced because of the faster movement of the piston

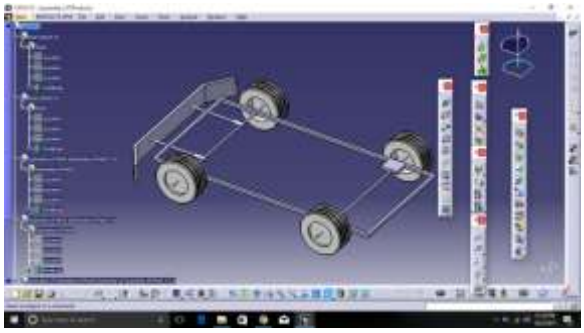
4. WHEEL ARRANGEMENT:

The simple wheel and braking arrangement is fixed to the frame stand.

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

5. STAND:

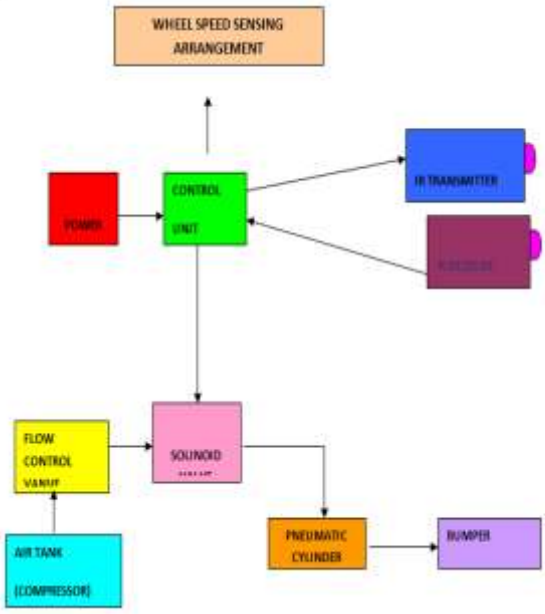
This is a supporting frame and made up of mild steel.



6. WORKING OPERATION

The impartant components of our project are,

- IR transmitter
- IR receiver
- Control Unit with Power supply
- Solenoid Valve
- Flow control Valve
- Air Tank (Compressor)



The IR TRANSMITTER circuit is to transmite the Infra-Red rays. If any obstacle is there in a path, the Infra-Red rays reflected. This reflected Infra-Red rays are received by the receiver circuit is called “IR RECEIVER”.

The IR receiver circuir receives the reflected IR rays and giving the control signal to the control circuit. The control circuit is used to activate the solenoid valve. The operating principle of solenoid valve is already explained in the above chapter. If the solenoid valve is activated, the compressed air passes to the Single Acting Pneumatic Cylinder. The compressed air activate the pneumatic cylinder and moves the piston rod.

If the piston moves forward, then the breaking arrangement activated. The breaking arrangement is used to break the wheel gradually or suddenly due to the pistion movement. The breaking speed is varied by adjesting the valve is called "FLOW CONTROL VALVE".

In our project, we have to apply this arrangement in one wheel as a model. The compressed air drawn from the compressor in our project. The compressed air flow through the Polyurethene tube to the flow control valve. The flow control valve is connected to the solenoid valve as mentioned in the block diagram

DESIGN ANALYSIS

PNEUMATIC CYLINDER:

i) Design of Piston rod:

Load due to air Pressure.

Diameter of the Piston (d) = 40 mm

Pressure acting (p) = 6 kgf/cm^2

Material used for rod = C 45

Yield stress (σy) = 36 kgf/mm^2

Assuming factor of safety =2

Force acting on the rod (P)= Pressure x Area

$$= p \times (\Pi d^2 / 4)$$

$$= 6 \times \{(\Pi \times 4^2) / 4\}$$

$$P = 73.36 \text{ Kgf}$$

Design Stress(σy) = σy / F0 S

$$= 36 / 2 = 18 \text{ Kgf/mm}^2$$

$$= P / (\Pi d^2 / 4)$$

$$d = \sqrt{4 p / \Pi [\sigma y]}$$

$= \sqrt{4 \times 75.36 / \{\Pi \times 18\}}$

$= \sqrt{5.33} = 2.3$ mm

∴ Minimum diameter of rod required for the load=2.3 mm

We assume diameter of the rod = 15 mm

ii) Design of cylinder thickness:

Material used = Cast iron

Assuming internal diameter of the cylinder= 40 mm

Ultimate tensile stress = 250 N/mm^2 = 2500 gf/mm^2

Working Stress = Ultimate tensile stress / factor of safety

Assuming factor of safety= 4

Working stress (ft) = 2500 / 4 =

= 625 Kgf/cm^2

According to 'LAMES EQUATION'

Minimum thickness of cylinder (t) =

$Ri \{\sqrt{(ft + p) / (ft - p)} - 1\}$

Where, Ri= inner radius of cylinder in cm.

ft= Working stress (Kgf/cm^2)

p= Working pressure in Kgf/cm^2

∴ Substituting values we get,

$t = 2.0 \{\sqrt{(625 + 6) / (625 - 6)} - 1\}$

$t = 0.019$ cm = 0.19 mm

We assume

We assume Thickness of cylinder = 2.5 mm

Inner diameter of barrel = 40 mm

Outer diameter of barrel = 40 + 2t

= 40 + (2 x 2.5)

Outer diameter of barrel = 45 mm

iii) Length of piston rod:

Approach stroke = 160 mm Length of threads = 2 x 20 = 40mm

Extra length due to front cover = 12 mm

Extra length of accommodate head = 20 mm

Total length of the piston rod = 160 + 40 + 12 + 20

= 232 mm

By standardizing, length of the piston rod = 230 mm

COST EQUIPMENTS

The cost material is selected as per the price list of 2017.

MATERIAL COST:

Sl. No.	PARTS	Qty.	COST(Rs)
i.	Single Acting Pneumatic Cylinder	2	3000
ii.	Flow Control Valve	1	300
iii.	Wheel	4	4000
iv.	Solenoid Valve	2	1100
v.	Single Phase induction	1	2200

	Motor		
vi.	Sensor Unit	1	1800
vii.	Pulley	2	700
viii.	Polyethylene Tube	-	400
ix.	Hose Collar and Reducer	-	500
X	Stand (Frame) including fabrication cost	-	3000
Xi	Wires, nut & bolts, electrodes & other	-	1000

7. APPLICATIONS

- For automobile application
- Industrial application

8. ADVANTAGES

- Free from wear adjustment.
- Less power consumption
- It gives simplified very operation.
- Installation is simplified very much

9. DISADVANTAGES

- Additional cost is required to install this arrangement in the vehicle .

VI. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The PNEUMATIC BUMPER FOR FOUR WHEELER is working with satisfactory conditions. We are able to understand the

difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities.

REFERENCES

1. Dr. R.K. Bansal, A text book of Strength of Materials, Laxmi Publications (P) Ltd.
2. R.S. Khurmi, J.K. Gupta, A textbook of Machine Design, S.Chand Publishing House (P) Ltd.
3. G.B.S. Narang, "Automobile Engineering", Khanna Publishers, Delhi, 1991, pp 671.
4. William H. Crowse, "Automobile Engineering".
5. Pneumatic Control System----Stroll & Bernaud, Tata Mc Graw Hill Publications, 1999.
6. Pneumatic System----Majumdhar, New Age India International (P) Ltd Publishers, 1997.