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Design and Fabrication of Sensor Operated Intelligent Braking System

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Abstract--- *The technology of pneumatics has gained tremendous importance in the field of workplace rationalization and automation from old-fashioned timber works and coal mines to modern machine shops and space robots. It is therefore important that technicians and engineers should have a good knowledge of pneumatic system, air operated valves and accessories. The air is compressed in an air compressor and from the compressor plant the flow medium is transmitted to the pneumatic cylinder through a well laid pipe line system. To maintain optimum efficiency of pneumatic system, it is of vital importance that pressure drop between generation and consumption of compressed air is kept very low. The aim is to design and develop a control system based an intelligent electronically controlled automotive braking system is called "AUTOMATIC REVERSE BRAKING SYSTEM". This Braking system is consists of IR transmitter and Receiver circuit, Control Unit, Pneumatic breaking system. The IR sensor is used to detect the obstacle. There is any obstacle in the path, the IR sensor senses the obstacle and giving the control signal to the breaking system. The pneumatic breaking system is used to break the system.*

Keywords--- *Design and Fabrication, Braking System, Braking Circuit, Tip Truck (AU).*

I. INTRODUCTION

We have pleasure in introducing our new project "Automatic Reverse Braking System", which is fully equipped by IR sensors circuit and Pneumatic breaking circuit. It is a genuine project which is fully equipped and designed for Automobile vehicles. This forms an integral part of best quality. This product underwent strenuous test in our Automobile vehicles and it is good.

The "PNEUMATIC BRAKING CIRCUIT" can stop the vehicle within 2 to 3 seconds running at a speed of 50 KM. The Reverse breaking system is a fully automation project.

Safety is a necessary part of man's life. Due to the accident cases reported daily on the major roads in all parts of the developed and developing countries, more attention is needed for research in the designing an efficient car driving aiding system. It is expected that if such a device is designed and incorporated into our cars as a road safety device, it will reduce the incidence of accidents on our roads and various premises, with subsequent reduction in loss of life and property.

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However, a major area of concern of an engineer should be safety, as it concerns the use of his/her inventions and the accompanying dangers due to human limitations. When it comes to the use of a motor vehicle, accidents that have occurred over the years tell us that something needs to be done about them from an engineering point of view.

According to the 2007 edition of the Small-M report on the road accident statistic in Malaysia, a total of 6,035 people were killed in 2000 and the fatality spring up to 6,287 in 2006 from accident cases reported in 250,429 and 341,252 cases of accident for 2000 and 2006 respectively. The obtained results show that, high rate of accident is reported each year.

II. FUNCTION

A dump truck (or, UK, dumper/tipper truck) is a truck used for transporting loose material (such as sand, gravel, or dirt) for construction. A typical dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic pistons to lift the front, allowing the material in the bed to be deposited ("dumped") on the ground behind the truck at the site of delivery. In the UK and Australia the term applies to off-road construction plant only, and the road vehicle is known as a tipper, tipper lorry (UK) or tip truck (AU).

History

Robert (2001) has presented various forms of aluminum alloys and their applications. Based on his survey on the growth of aluminum alloys, he concluded that 32.2 % of the aluminum was consumed in transport industry in different forms. Foltz and Charles (1991) have presented various matrix alloys, reinforcements and their applications in space, defense, automotive and electronic packaging.

Applications of metal matrix composites in defense, aerospace and light vehicles have been reported by Rittner (2001). She has concluded that the scope for MMC in all the above areas were optimistic and suggested further improvement in processes, selection of alloy, selection of reinforcement and selection of components to reduce the cost of end product.

III. LITERATURE REVIEW

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They also presented the possible applications of MMCs in making automotive components like pistons, cylinder sleeve, connecting rod and brake discs. Many Researchers (Suresh et al.1993; Kevorkijan 1999; Rohatgi 1991; Nakanishi et al. 2002) have presented the applications of MMCs for the automotive components and the feasibility of manufacturing these materials.

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Surappa (2003) has presented an overview of aluminum matrix composite material systems on aspects relating to processing, microstructure, properties and applications. Many challenges of using the metal matrix composites are producing high quality and low cost reinforcements, developing simple economical and portable non-destructive kits to quantify undesirable defects, developing less expensive tools for machining and cutting and also developing re-cycling technology. The following chapters discuss the issues in design and manufacturing of an automobile brake drum.

Pneumatic Cylinder

Cylinder is a device which converts fluid power into liner mechanical force and motion. These cylinders are widely used in industrial pneumatic systems. These cylinders are also called as linear motors and reciprocating motors pneumatic cylinders are designed for a variety of services.

Pneumatic cylinders are designed for a variety of services. Pneumatic cylinders transforms the flow of pressured fluid into a push or pull of the piston rod since out system uses double acting cylinders we shall see some details about them.

Double acting cylinders are in one in which fluid force can be applied to the movable element in two directories. The force exerted by the compressed air moves the piston in two directories in a double acting cylinder. They are used particularly. The piston is required to perform work not only on the advance movement but also on the return. In principle, the stroke length is unlimited, although bucking and bending must be considered before we select a particular size of piston diameter, rod length and stroke length.

The main component of any pneumatic system is the cylinder, which receivers air under pressure and the pressurized air helps to move the piston to and fro. The force acting on the piston will be equal to the product of the pressure of air and the area of the cylinder. The amount of air delivered into the cylinder into the cylinder decides the rate of doing work. A cylinder is a hollow circular section with the top and bottom flange provided to prevent the leakage of air.

The compressed air is used to actuate the piston. In order to move the piston to and fro, the air is supplied to the top and bottom of the cylinder alternatively.

Cylinder is mainly classified into two types namely,

- Single acting cylinder.
- Double acting cylinder.

In single acting cylinder, using the spring provided around the piston rod attains the return stroke, but it is not efficient. So, the double acting cylinder is used in which the return stroke is attained using compressed air.

Double Acting Cylinder

In this the force exerted by the compressed air moves the piston in two directions. They are used partially when the piston is required to perform work not only on the advance movement but also on the return stroke. This principle, the stroke length is unlimited, although bucking and bending must be considered before selecting the particular size of piston diameter, rod length and stroke length.

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Solenoid Valve

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.

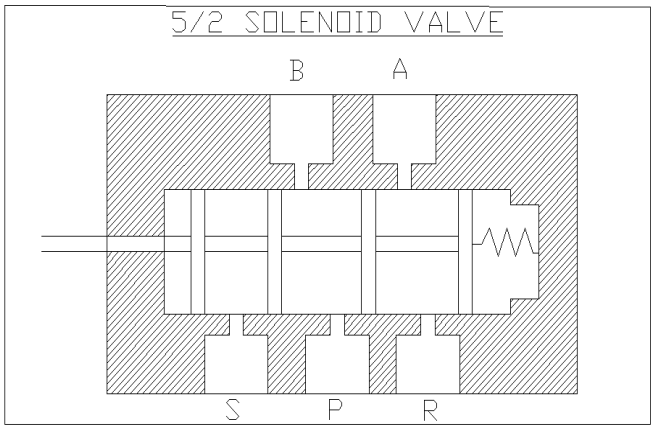
This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used 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 in 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.

Working of Solenoid Valve

The solenoid valve has 5 openings. This ensure easy exhausting of 5/2 valve. The spool of the 5/2 valve slide inside the main bore according to spool position; the ports get connected and disconnected. The working principle is as follows.



Position-1

When the spool is actuated towards outer direction port ‘P’ gets connected to ‘B’ and ‘S’ remains closed while ‘A’ gets connected to ‘R’

Poisition-2

When the spool is pushed in the inner direction port ‘P’ and ‘A’ gets connected to each other and ‘B’ to ‘S’ while port ‘R’ remains closed.

House and Fittings

It is provided for the passage of compressed air from the compressor outlet to the operating valve.

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Two separate pipes also connect the operating valve with the working cylinder pressure drop through and airline depends on the flow rate, pipe diameter, and pipe length and pipe geometry. It can be determined directly for straight pipes of any given length. A small chaining bore size can have marked effect on pressure drop, whereas even doubling the pipe length, will only result in doubling the pressure drop.

Pressure drop through bends and fittings can only be determined by empirical tests, since it is specific to the internal geometry involved. Rigid pipes however are less manipulated through remain form of bends with arrangements increase and variable air have to flow and the flow itself may be of fluctuating or pulsating nature. In this case it is thus normally based on practical recommendation.

Double Acting Pneumatic Cylinder

- Stroke length : Cylinder stoker length
- 160 mm = 0.16 m
- Quantity : 1
- Seals : Nitride (Buna-N) Elastomer
- End cones : Cast iron
- Piston : EN – 8
- Media : Air
- Temperature : 0-80 º C

Pneumatic Cylinder Design

Design of Piston Rod

Load due to air Pressure.

Diameter of the Piston (d) = 40 mm

Pressure acting (p) = 6 kgf/cm²

= 6 ×0.981

= 5.886 bar = 0.5886N/mm^2

Material used for rod = C 45

(Data book page no 1.12)

Yield stress (σ_y) = 36 kgf/mm²

= 36×98.1

= 3531.6 bar

= 353.16N/mm^2

Factor of safety = 2(data book page. no 8.19)

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

= p x (Πd² / 4)

= 0.5886 x {(Π x 40²) / 4}

F = 739.6 N

Design Stress (σ_y) = σy / F0 S

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$= 353.16 / 2 \qquad = 176.5 N/mm^2$

$\therefore d = \sqrt{4F/\pi [\sigma y]}$

$= \sqrt{(4 \times 739.6)/ \pi [176.5]}$

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

We assume diameter of the rod = 15 mm

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.

Working Principle

The **IR TRANSMITTER** circuit is to transmit 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 circuit receives the reflected IR rays and giving the control signal to the control circuit. The control circuit is used to activate the solenoid valve. If the solenoid valve is activated, the compressed air passes to the Double 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 piston movement. The breaking speed is varied by adjusting the valve is called **"FLOW CONTROL VALVE".**

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

Advantage and Application

Advantage

- Brake cost will be less.
- Free from wear adjustment.
- Less power consumption
- Less skill technicians is sufficient to operate.
- It gives simplified very operation.
- Installation is simplified very much.
- To avoid other burnable interactions viz.… (Diaphragm) is not used.

Less time and more profit

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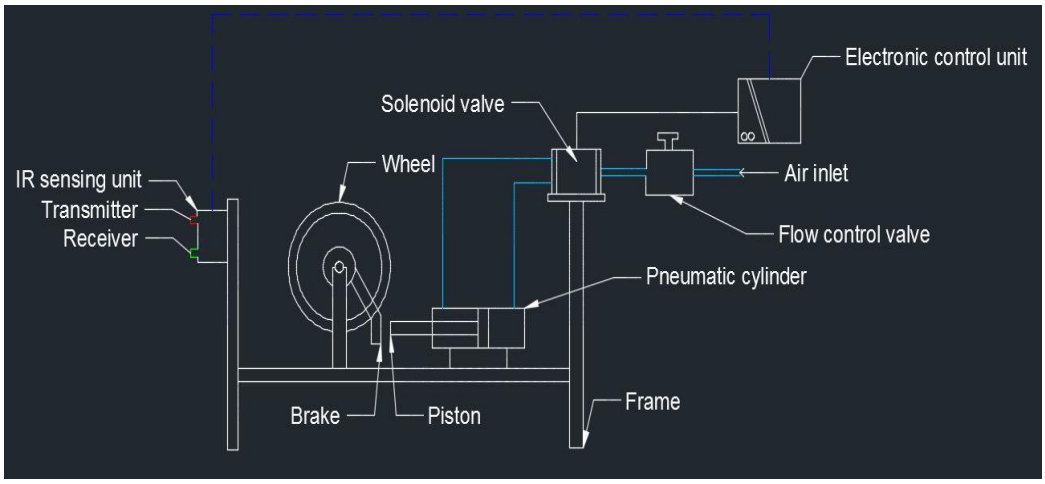
Applications

- For automobile application.
- industrial application



ABOUT THE AUTHOR

Behind **William H. Crouse's** clear technical writing is a background of sound mechanical engineering training as well as a variety of practical industrial experiences. He spent a year after finishing high school working in a tinplate mill, summers, while still in school, working in General Motors plants, and three years working in the Delco-Remy Division shops. Later he became Director of Field Education in the Delco-Remy Division of General Motors Corporation, which gave him an opportunity to develop and use his natural writing talent in the preparation of service bulletins and educational literature. During the war years, he wrote a number of technical manuals for the Armed Forces. After the war, he became Editor of Technical Education Books for the McGraw-Hill Book Company. He has contributed numerous articles to automotive and engineering magazines and has written several outstanding books: Automotive Mechanics, Electrical Appliance Seedling, Everyday Automobile Repairs, Everyday Household Appliance Repairs, and Understanding Science. William H. Crouse's outstanding work in the automotive field has earned for him membership in the Society of Automotive Engineers and in the American Society for Engineering Education.

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