Pneumatically designed circuit to cover metro platform gap

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***Abstract*---Managing gap safety at the train platform interface has been an on-going concern for Metro train systems. The objective of my research is to cover this gap between the metro-car floor and platform. Metro-Platform gap cannot be eliminated as Metro sways due to high speed and mass. If the width of Gap is decreased, the train will infringe on the platform edge. The gap will be covered by a metal plate which will be actuated with the help of a pneumatic circuit. The circuit consists of a pneumatic actuator, two direction control valves and a pressure tank. The circuit will be actuated by the opening and closing of metro doors automatically. The circuit will be placed on the threshold area of the metro train. Further, by the utilization of the Train-to-Platform Gap Alleviator device all railcar vehicles will be readily accessible and useable by those with disabilities, the infirm, children, teenagers and adults.**

I. INTRODUCTION

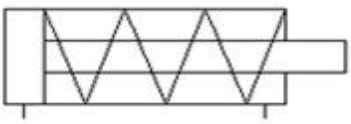
In this research, knowledge of pneumatics which is a branch of engineering is used to reduce the metro platform gap .Pressurized air /gas is used to cover the gap. Various pneumatic components are arranged together to convert the pressurized gas potential energy into a kinematic energy to cover the gap. Selection of a proper material for plate to meet desired mechanical properties and lower cost is the main concern. Various pneumatic components required to carry out the research are Pneumatic cylinder, 3/2 direction control valve, 5/2 direction control valve, Pneumatic tubes and pressure tank.

II. METHOD

There are four types of actuation systems that can be used to cover the metro platform gap. Pneumatic system, Hydraulic system, Electrical system and Mechanical system. Let us look at the advantages of pneumatic system over other actuation systems. Pneumatic system uses air to transmit power , they produce no pollutants. Leaks will not cause spills of toxic chemicals. Pneumatic machine tends to be very simple and requires less maintenance than other types of machinery. Compressed air can be stored in a container, it is always available even when electricity goes off. Very little fire hazards .Unlike hydraulic systems, no return line is required because air can be released to the atmosphere.

Now, I am listing down the various pneumatic components that were used to cover the metro platform gap.

1) Pneumatic cylinder : Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Pneumatic cylinders use the stored potential energy of a fluid, in this case compressed air, and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be



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2) 3/2 direction control valve : A 3/2 direction control valve consist of 3 ports which are used in 2 ways or direction. It is usually actuated by a push button. A 3/2 valve would be used to allow fluid flow into or out of actuator or motor.

3) 5/2 direction control valve : This valve consists of 5 ports which are connected in 2 ways.

4) Pneumatic tubes : Pneumatic tubes (or capsule pipelines; also known as Pneumatic Tube Transport) are systems in which cylindrical containers are propelled through a network of tubes by compressed air or by partial vacuum.

5) Pressure tank: A pressure vessel is a closed container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. Here only a small pressure tank is required.

Working Principle:

STEP I: The pneumatic circuit consisting of two pneumatic valves and a hydraulic cylinder will be actuated with the opening of the METRO DOOR.

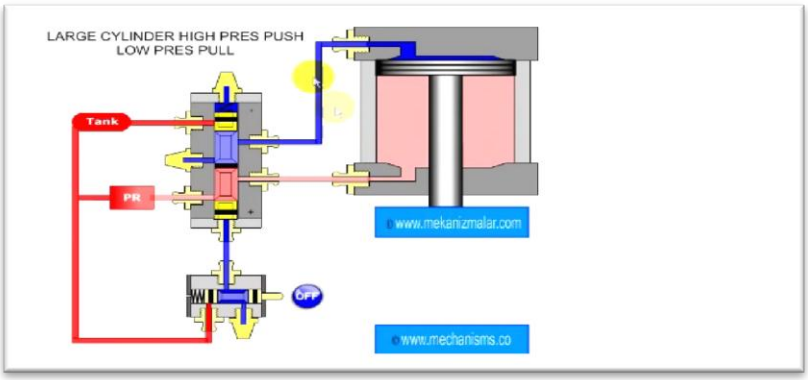

Fig I

STEP II : The metro door will hit the push button of the **3/2 Direction control valve** and will actuate it. With the actuation the pressure from pressure tank will be transferred to the **5/2 Direction control valve.**

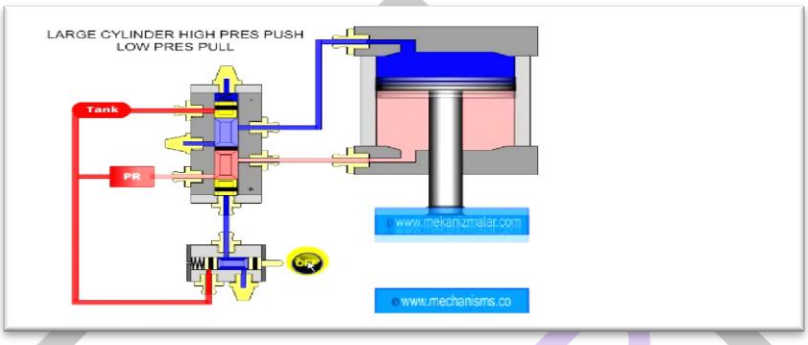

Fig II

STEP III: The pressure from pressure tank transferred to **5/2 Direction control valve** will be further passed to the Pneumatic cylinder. This pressure will force the piston down and the Platform-Metro gap will be covered.

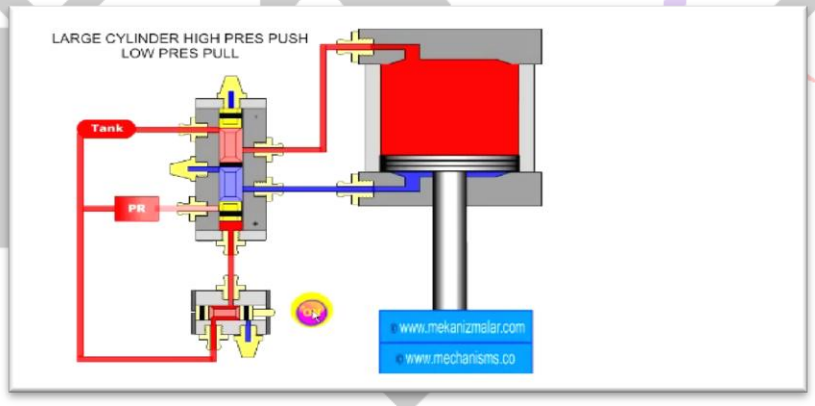

Fig III

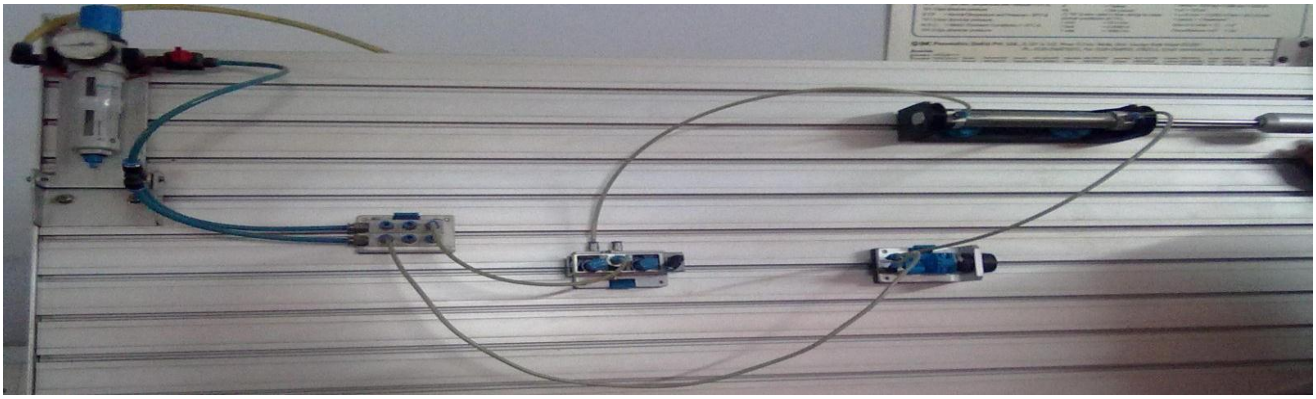

Fig IV. Fabricated pneumatic circuit

Some characteristics of pneumatic systems are discussed here. Stroke from a few millimetres to meters in length (longer strokes have more springiness).Pressures are typically up to 85psi above normal atmosphere .Weight of pneumatic cylinders are quite low. Additional equipment is required for a pressurized air supply-linear and rotatory actuators are available .Dampers can be used to cushion impact at ends of cylinder travels.
Pneumatic cylinder of double acting type is used in the research:-
Stroke= 200mm
Bore=100 mm
Operating pressure gauge=0-10 bar
Length of connecting rod= 200mm
Length of crank=100mm
Time of single stroke=1.5sec

III. MATERIAL SELECTION

To cover the metro platform gap the piston is welded with a metal plate. Here the metal plate used is of rail steel which is fulfilling all the required parameters. Dimension of plate required (1.25 X 0.154)meter sq. Selection of plate material is done on the basis of : Minimum cost. Suitable mechanical properties (stress and bending analysis). Properties of rail steel are : Corrosion resistant, high strength ,easy to machine, easily available and hard.
TENSILE STRENGTH= 900MPa TO 1200MPa
BRINELL HARDNESS NUMBER = 280

IV. RESULT

The pneumatic cylinder used is of bore diameter 50mm and stroke length 200 mm.
A pressure regulator installed will control the volume of compressed air injected into the cylinder.
The piston movement is actuated by the pneumatic action between 5/2 direction control valve and the actuator. This actuation pushes out the piston and plate attached to it.
When a pressure of four bar was created the displacement of three inches of the piston rod was recorded. The metal plate was welded to the piston rod.
The project is tested on a four bar pressure which is supplied to it with an external compressor. The plate could bear maximum load of 300N.The total distance covered by the plate is 5 inches. Suitable material selected for fabricating the metal plate was rail steel as it was fulfilling all the desired parameters.
The arrangement of cylinder-piston, 5/2 DCV and connecting pipes will transmit the power to the piston rod. This whole arrangement is levered by the opening and closing of the metro doors manually. Further, by the utilization of the system all railcar vehicles will be readily accessible and usable by those with disabilities, the infirm, children and adults.

V. CONCLUSION

The pneumatic gap reducer is designed for comfortable boarding and de-boarding of commuters.
In order to supply the compressed air to the pneumatic cylinder, continuous availability of compressed air is necessary. This can be done by installing a reservoir that could store compressed air. This reservoir will contain the compressed air and will be connected directly to the inlet of pneumatic cylinder through a cut- off valve.
Also, the idea of this gap reducer is to cut down cost and to remove the dependency of fuel. Since it runs with the power produced from compressed air, there is a need of conventional fuels like petrol or diesel. This will keep the long-time cost low and at the same time it will prove to be an asset to keep the atmosphere pollution free. There are no pollutants as there are no exhaust gases from combustion are produced. This gap reducer is easy to use and also it is eco- friendly.

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