DESIGN AND DEVELOPMENT OF TRAIN STAIRCASE MECHANISM FOR EASY ACCESSIBILITY OF PASSENGERS TO ACHIEVE LOW LEVEL PLATFORM

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ABSTRACT

Automatic Staircase Using Pneumatic Actuators & IR Sensors serves to automate the mechanism of Staircase operation using Pneumatic, controller and infrared sensor technology. The methodology applied in the project is divided into three parts, firstly designing and fabrication of the Staircase with the calculated dimensions, secondly, developing a controller for door operation and thirdly, interfacing the different components to work together in a cohesive manner to adjust the height of Staircase at each platform level. When a platform comes in or goes out of the range of the sensor, a signal is sent to the controller which controls the electro-pneumatic circuit to open or close the Staircase as per required height of steps. The significance of this system is automation of the Staircase which can be customized according to the use. Based on the results obtained an actual working prototype was designed and a suitable large scale will develop taking into account the platform height conditions.

Keyword: - *Automatic staircase, platform height, Electro-Pneumatics Control, IR Proximity sensor, Train.*

1. INTRODUCTION

Presently, Indian Railways (IR) AC 3-Tier Sleeper Coaches of ICF design to CSC-1722 have a floor height of 1320 mm from rail level and have a customized design of complete entraining/ detraining arrangement including door with fixing arrangement, footsteps and door handle compatible with platform of height 760mm to 840mm from rail level in such a way that passenger during entraining from platform to coach floor uses a vertically straight parallel foot-steps and similarly during detraining from coach floor to platform. The Challenge is design a mechanism of operation of a convenient method of train access from low level platforms in a failsafe mode. The innovations may particularly look at opportunities of easy retro-fitment and seamless integration in the current design of coaches serving different age groups and physical capabilities. The Challenge aims to encourage creation of innovative, easy to use designs and solution that can enable convenient access to all kinds of passengers (of diverse ages and special requirements) without infringing the current constraints of fixed infrastructure at the station and along the trackside.

1.1 OBJECTIVE

To overcome this problem, mention above, we have to design the Automatic staircase System with electro-pneumatic control which has following objectives,

To increase the sureness of safety while walking down the train.

To reduce the chances of injuries & accidents in train travelling.

To performed the most rigid operation with high automatic height adjustable staircase.

To improve the safety while passengers walk out from train at local villages stations where staircase height is not match with ground.

To adjustment staircase height with proper design & development of stairs.

1.2 SCOPE

This system will provide height adjustable steps for train boogies. In future this new mechanism will replace a conventional rail boogies in place of mechanical fixed type staircase. By using this system which steps will cover insufficient space to reach ground for passengers while walk out from train to overcome this problem.

2. DESIGN

We know the basic idea of mechanism which we are going to use, so we created a design using 3d software for the basic idea of mechanism of adjustable stair case for train boogie.

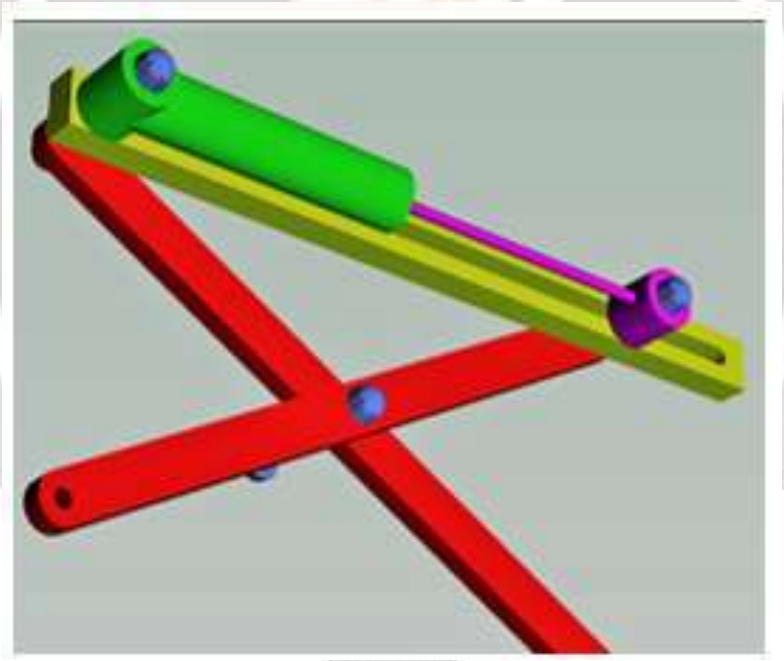

Fig -1: Concept of adjustable staircase for train boogie

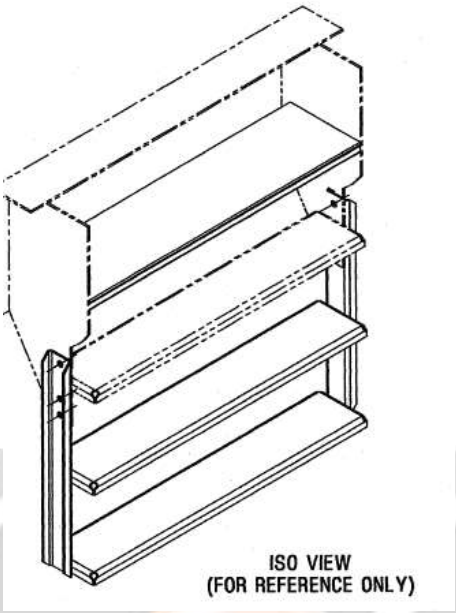

Fig -2: ISO View of train staircase

2.1 COST

Table -1: Cost Sheet

SR.NO	Component	Quantity	Cost in Rs.
1	Double acting cylinder	1	800
2	5/2 solenoid dcv	1	750
3	Flow control valve	2	75
4	Relay	1	750
5	Infrared sensor	1	950
6	Pneumatic connectors	4	40
7	Nut and bolt	20	5
8	Wire	3Mtr.	10
9	Pneumatic tube	3Mtr.	25
10	Wheels	4	250
11	12 volt battery	1	950
12	Plywood	1	100
13	On/off switch	1	40

2.2 COMPONENT LIST

We used following components in our project

- List Item – 1
    1. Frame
    2. Double Acting Cylinder
    3. Pneumatic Pipe Fittings
    4. Pneumatic connectors, reducer and hose collector
    5. Solenoid type 5/2 DCV
    6. Relay Board
    7. IR sensor

3. PROCESS OF WORKING

This project consists of pneumatic control staircase system which is mounted on base end side of movable boogie platform on M.S. frame stand. A compressed air is supply through compressor using solenoid direction control valve DCV from remote air tank to double acting cylinder and automatic staircase adjust the particular required height with the application of IR sensor operation when it senses the particular height steps will stretch or contract as per required platform height. When we required operating the staircase system, then to operate the solenoid direction control valve DCV automatically with the application of sensor by 12 Volt batteries. So that the air from DCV is passes through DCV to actuate the stair case height. The boogie operated manually for giving motion for showing actual working as per different platform height. Here we use pneumatic double acting cylinder which having two ports for inlet and outlet of compressed air. Double acting cylinders are available in variety of sizes with low cost application in pneumatics.

3.1 ADVANTAGES

1. An Automatic staircase Control is implemented with very simple hardware and easy control.
2. Human intervention at level crossings can be removed with the help of this project and many railway accidents can be prevented.
3. It will give better output as compared to another type of staircase systems. This system has higher efficiency as compared to others staircase in safety point of view.
4. There are very rare chances of an accident during down the staircase.

3.2 APPLICATION

It is used for adjustable steps of railway boogie with automation system.

4. CONCLUSIONS

We developed just a model of the pneumatic automated train stairs which will perform desired operation to lower or rise approximate 5kg sample load effectively. In this we have used piston-cylinders and pneumatic control with required specifications. But if we want to develop a actual model of stairs that is to be used in the train, we can use the piston-cylinders and hydraulic or pneumatic controls with higher stroke and capacity to increase the efficiency of the system.

The concept develop by us is fulfill all the requirements of objectives given in report. The main objective of this project is to easy accessibility to train passengers for low level platform. The specific objectives of this project were the protection of lively hood & to reduce accidents during traveling on train. The result of that system can sense the change in hydrostatic pressure difference while brake & staircase operation automatically.

5. REFERENCES

[1] Jing-Shan Zhao, Jian-Yi Wang, Fulei Chu, Zhi-Jing Feng & Jian S. Dai, Mechanism Synthesis of a Foldable Stair, Journal of Mechanisms and Robotics Copyright VC 2012 by ASME FEBRUARY 2012, Vol. 4 / 014502-1, pp.1-7.

[2] Justin M. Thomas, Justin Joe Kappil, Kevin Peter N. Aravind Krishna, Design & Fabrication of Electro Mechanical Ladder, IJIRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 11 | April 2016,pp.145-150.

[3] Mangesh Wagh, Saurabh Pawar, Kiran Mane, Aditya Dhumal, Prof. D. P. Mali,Design and Manufacturing of Pneumatically Operated Stairs by using Scissor Mechanism,IJSRD - International Journal for Scientific Research & Development| Vol. 7, Issue 02, 2019 | ISSN (online): 2321-0613,pp.548-549.

[4] Wei ZHANG, Xuefei ZHANG, Chao YAN, Shujie XIANG and Liwen WANG. A characteristic triangle method on input vectors of scissor lift mechanism and its applications in modeling and analysis, Journal of Advanced Mechanical Design, Systems, and Manufacturing, Vol.9, No.3, 2015,pp.1-20.