

# Design and Manufacturing of Pneumatically Operated Stairs by using Scissor Mechanism

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**Abstract**— In many mechanical Industries machinery is on the top or place the floor wise. For excess purpose stairs are used. But for stairs more space is required. For space saving, there is improper design of stairs and it is very unsafe for workers to work there. Due to such stairs chances of accidents or increases. To overcome space problem this project deals with compact design of stairs. Due to compact design space utilization is less and due to proper design, there are very less chances of accidents. The stairs operate on scissor mechanism by pneumatic which is safer than hydraulic operation.

**Key words:** Actuator, Connecting Rod, Vertical Link, Horizontal Link, Slider

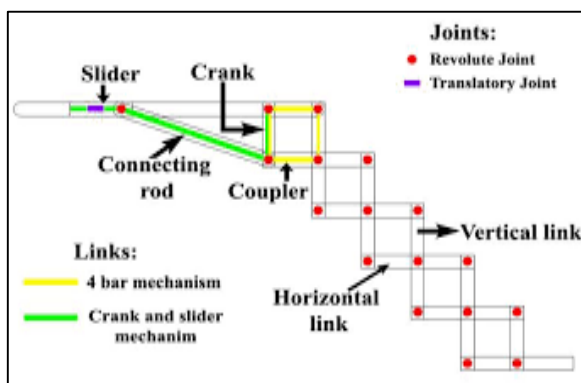
## I. INTRODUCTION

Pneumatics has long since played an important role as a technology in the performance of mechanical work. It is also being used in the development of automation solutions. Pneumatic systems are similar to hydraulic systems but in these systems compressed air is used in place of hydraulic fluid.

A pneumatic system is a system that uses compressed air to transmit and control energy. Pneumatic systems are used extensively in various industries. Most pneumatic systems rely on a constant supply of compressed air to make them work. This is provided by an air compressor. The compressor sucks in air from the atmosphere and stores it in a high-pressure tank called a receiver. This compressed air is then supplied to the system through a series of pipes and valves.

The word 'Pneuma' means air. Pneumatics is all about using compressed air to do the work. Compressed air is the air from the atmosphere which is reduced in volume by compression thus increasing its pressure. It is used as a working medium normally at a pressure of 6 kg/sq. mm to 8 kg/sq. mm. For using pneumatic systems, maximum force up to 50 KN can be developed. Actuation of the controls can be manual, pneumatic or electrical actuation. Compressed air is mainly used to do work by acting on a piston or vane. This energy is used in many areas of the steel industry.

## II. MECHANISM OF FOLDABLE STAIR



The foldable stair mechanism consists of links arranged in vertical and horizontal manner that make up the stair like arrangement. These links are connected with each other using revolute joints. The crank in the crank and slider mechanism, which pulls the entire set of links up or down makes the stair like arrangement. This crank also acts like an input link for the four-bar mechanism. This folding and unfolding of the stair resemble the scissor like structure. The crank is connected to the connecting rod through a revolute joint, which moves due to the actuation of the slider. The slider moves linearly due to the translator motion exhibited by the linear actuator. The construction of the mechanism is as shown in Fig 1. Two sets of this planar mechanism are placed parallel to each other at an offset distance. The horizontal links in the two sets are connected together by using a bar over which the foot of the user is placed.

### A. Parts of Foldable Stair Mechanism

#### 1) Vertical links

The vertical links are connected to the horizontal links at two or three points. It is used to fold or release the horizontal links when it is actuated by the crank. They decide the height of each step in the stair.

#### 2) Horizontal links

They are connected to the vertical links at two or three points through a revolute joint. It is used to provide a platform where the foot of the user can be kept. It decides the length of each step in the stair.

#### 3) Slider

The slider is used to actuate the mechanism due to its linear motion. It moves due to its attachment to the rod of the double acting cylinder at one end. The other end is joined to the connecting rod through a revolute joint.

#### 4) Connecting rod

It is connected to the slider through a revolute joint at one end and the other end is connected to the crank and coupler of the four-bar mechanism through a revolute joint. The connecting rod is utilized to transfer the linear motion of the slider to the rotary motion of the crank. By varying its length, the linear force needed for actuation and the linear distance to be moved by the slider varies which is studied in detail in this paper.

#### 5) Crank

The crank is used to transfer the motion from the connecting rod to the coupler. When it rotates, the motion is transferred to the horizontal link (coupler of the four-bar mechanism) which further causes the folding or unfolding of the foldable stair mechanism.

## III. PROBLEM STATEMENT

In many mechanical Industries machinery is on the top or place the floor wise. For excess purpose stairs are used. In places where there is a space restriction their traditional type of stairs is not suitable. There will be chances of accidents.

Stairs are improper in design due to space restriction. Material required for manufacturing traditional stairs is more.

#### IV. ADVANTAGES

- 1) Foldable Pneumatic stairs Easy to operate.
- 2) Space required is less than traditional stairs.
- 3) Avoid chances of accident. High load carrying capacity.
- 4) Maintaining cost is less

#### V. DISADVANTAGES

- 1) Initial Cost is high.
- 2) This system is use where air compressor is present.

#### VI. CONCLUSION

Thus, in this paper, a foldable stair mechanism actuated linearly is designed and discussed in detail. There are two such sets of mechanism placed at an offset distance from each other. The horizontal links in the two sets are connected together using a bar over which the foot of the user can be kept. The length of the connecting rod in the crank and slider mechanism places an important role in deciding the force needed for actuation and stroke length required. Thus, ten different lengths of connecting rod are taken into account and the force needed and stroke lengths required for actuation were analyzed. The mechanism was modelled and simulated to verify it's working. Then stress

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