DEVELOPMENT OF WALKER TO SUPPORT HIPS WHILE STANDING FROM SITTING

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Abstract - *This report presents about the walker with extension that has been used especially for the person who has hip pain or who is not able to stand properly from sitting position, also for the patients suffering from paralysis and spinal cord injuries such as arthritis, bursitis, sciatica hip labral tear etc. The purpose of this project is to make a person stand from sitting without any external support.*

A walker is a machine design for disabled or elderly people who need additional support to maintain balance. For user interface, it contains widely available platform with manual height adjustment. The platforms allow users without hand grasp capabilities to walk by placing their forearms on the platform and supporting body weight through the shoulders. This platform will move relative to the frame through extension or compression of bilateral gas springs. Two Gas spring actuator will be attach bilaterally to create the pneumatic elevator assembly. This makes for easier use of the walker, as it does not require any extra body force to lift the walker.

1. INTRODUCTION

This project present design and fabrication of the adjustable and portable walker with extension for the spinal cord patients and injured person that considers the height of the walker. This walker with extension would be different from the existing walker that already have in the market nowadays. The Final year major project allocates the duration of 2 semesters, this large man hour project requires significant efforts of the students to participate. Basically the entire Design and Fabrication of this project could be divided into 3 stages which are concept review and fabrication, designing and make finishing. The walker with extension for spinal cord injuries patients is equipped by using all items and methods for instance aluminium, screw, bearing, gas springs and also skills in manufacturing process like welding to join all the parts together. The advantages of the proposed walker with extension to be developed can be seen that the person will be independent. He/she will not require any extra person to make them stand. The process of fabrication is initiated from conceptual design stage by considering the advantages as well simplicity. Practical fabrication and design involves the measurement, marking, cutting the material into required dimensions, assembly and lastly is making finishing.

2. METHODOLOGY

2.1 DESIGN AND FABRICATION

The frame is similar to standard walker, which are stable and mobile but provide no lift assistance. To minimize weight & enhance modularity, the base will be constructed from aluminium alloy 6061 piping connected by structural fittings. A novel pneumatic elevator assembly will be design to lift the platform. Commercially available, remote release gas springs with range of motion will be choose as the actuators for the lifting mechanism. Each spring contains a locking valve controlled by a hydraulically actuated pin within the rod end, when the pin is released (the button is pushed) the rod end is free to move. When the pin is engaged the gas springs are locked at their current position.

2.2 MATERIAL SELECTION

The frame is being constructed from Aluminium alloy 6061 because of the following properties:

1. It is a medium to high strength heat-treatable alloy.
2. It is very good to corrosion resistance.
3. It has very good weld ability.
4. It has good machinability.

2.3 WORKING

For user interface it contains widely available platform with manual height adjustment. The platforms allow users without hand grasp capabilities to walk by placing their forearms on the platform & supporting body weight through the shoulders. This platform will move relative to the frame through extension / compression of bilateral gas springs. Materials are proposed for the fabrication of the walker is aluminium 6061 gas springs. Two gas spring actuators will be attach bilaterally to create the pneumatic elevator assembly. Vertical motion of the bilateral springs is coupled through a single hydraulic push button release system, allowing to release of bot springs with the push of one button is not compressed. Once upright, the button is released to lock the springs. To sit, the user simply pushes the button & user body weight to compress the cylinders.

2.4 GAS SPRING CONSTRUCTION

Gas springs can be defined as hydro-pneumatic, energy storage elements. Nitrogen gas and oil are utilized for providing compressible and damping (motion control) mediums. Gas springs can be configured to meet a wide range of requirements. Gas springs equation consist of a precision rod attached to a piston, moving within a sealed cylinder containing pressurized nitrogen gas and oil. Their force (F) is equal to the pressure differential (P) between internal and external (environment) pressures, acting on the cross-sectional area of the rod (A). While for most applications ΔP (pressure differential) can be approximated by the spring's internal pressure (P), ΔP must be taken in consideration for gas springs used in high pressure environments (e.g. Sub-sea applications).

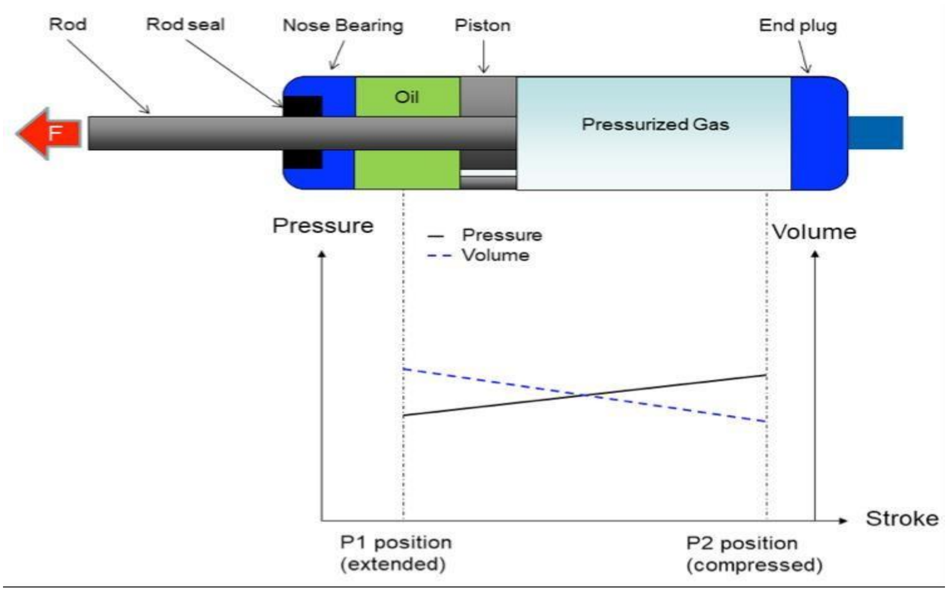


Figure 1 - Gas Spring schematic - Pressure / Volume vs. stroke diagram. As the piston moves from the fully extended position (P1) to the fully compressed position (P2), the pressure (solid line) rises and the volume (dashed line) reduces.

As the Piston rod introduced into the cylinder i.e, compressible stroke, the internal gas volume increases resulting in proportional increase in pressure (Boyle's law). Consequently the force of a gas spring is higher when the rod is compressed (see Fig. 1)

The difference between the forces seen at the two extreme rod positions- named P1-force and P2- force respectively- is an important gas spring characteristic and called K-factor (IGS) or gas spring progression. When compared to mechanical springs, gas springs can achieve very low K-Factors, typically ranging from 1.05 to 1.8 (or %-80% progression). Unlike coil springs, gas springs are pre- loaded (pressurized) at the required P1-force which is available immediately.

For this reason, P1 force must be taken in account when calculating the force of a gas spring at a given position:

Where F is the force of a gas spring, k is the spring constant expressed in N/mm (force change per unit of compression) and X is the deflection distance in mm.

3. LITERATURE REVIEW

The following resources helped us getting an insights about the walkers, therefore converting our abstract idea into solid form-

1. 31 Dec 2010, 26(5):470-476 DOI: 10.1016/j.clinbiomech.2010.12.004 PMID: 21196069 PMCID: PMC3086955

In this paper author draws our attention towards to compare upper and lower extremity force requirements during a sit-to-stand task. The data is from testing participants recovering from a hip fracture.

2. 01 Aug 2011, 113(1):229-241 DOI: 10.2466/10.15.26.pms.113.4.229-241 PMID: 21987922

In this paper researches draws our attention toward wrist deviation and vertical force among elderly individuals using a walker for assistance to stand up and sit down.

3. 12 Mar 2012, 6(1):14504-NaN DOI: 10.1115/1.4005786 PMID: 23904904 PMCID: PMC3707190

In this a detailed steps for the design, development and fabrication of walker is given. It suggest how we can use bilateral gas springs so that we can design non-electrically powered walker to provide upward lift.

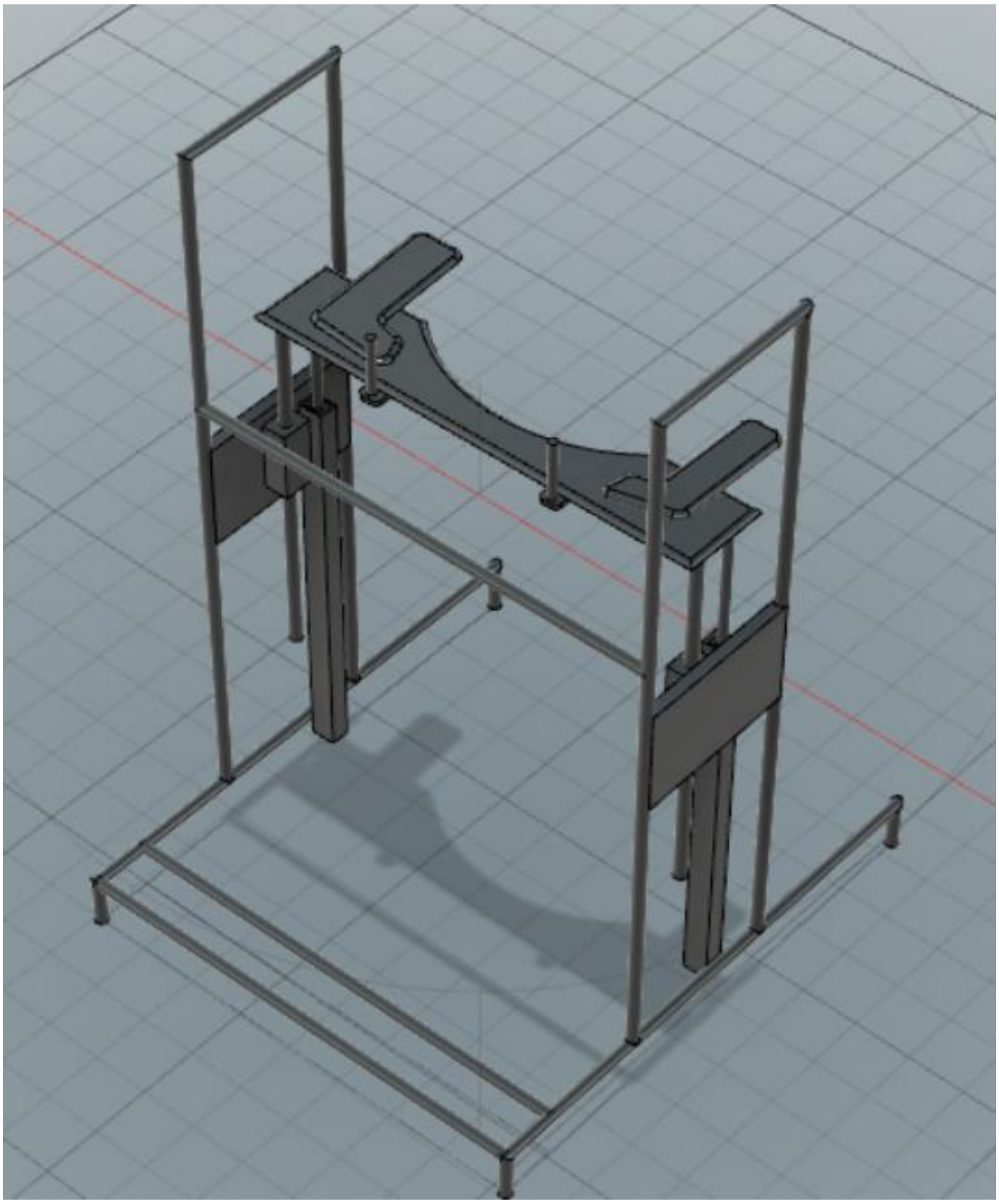
4. 30 Sep 2017, 81(1):81-86 DOI: 10.1016/j.jcma.2017.04.009 PMID: 28974355

In this paper, design of additional armrest is given. It can be attached to a standard walker for users performing sit-to-stand transaction more easily and evaluate it with clinical assessments and a body worn sensor.

DIMENSION	MEASUREMENT
LENGTH	0.8 meter
Breadth	1 meter
Side Support rod height	1.35 meter
Platform rest height	0.85 meter

Table 1- Approximate dimension of the purposed Walker

4. CAD MODEL



5. CONCLUSIONS

By taking into consideration of all the aim and objectives of our project, we are concluding that the patient will surely become independent. And will be able & comfortable to stand from sitting position without any pain in hips & without any other external forces applied by his/her body through the walker with extension. Adding to this, patient will be able to stand even if he/she is in lying condition.

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