Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Developing of Self Reclining Wheelchair
(SRWC)

Arun C Antony[1], Arun Titus K[2], Aron Antony[3], Christy Mathew [4]
[1,2,3] UG Scholar, Department of Mechanical Engineering, NCERC, Kerala, India
[4] Assistant Professor, Department of mechanical engineering, NCERC, Kerala, India

***Abstract*—DEVELOPING OF SELF RECLINING WHEELCHAIR (SRWC) was initiated only when we realized that the present market could not provide a self-reliable reclining wheelchair. Mainly our project aims on developing an independent working mechanism so that the person on the wheel doesn't require the help of a caregiver to recline the wheelchair.**

The present market can provide the reclining wheelchairs which require the help of a second person to recline it for the person on the wheel. This problem of all time assistance required for a paraplegic patient can be avoided by using our mechanism. Whenever a paraplegic patient requires the help of a care giver to lie down to a bed he either requires a crutches or the help of a caregiver, instead by depending on our self-reclining wheelchair (SRWC) the patient doesn't require the help of a care giver thus he himself can use the handle on the sides to recline the front and back rests.

By developing SRWC we can also take into consideration that stretchers in the hospitals can be replaced by SRWC thereby reducing the space lost mainly in a government hospital of very limited space. Thus the SRWC provides a dual purpose medical support as a wheelchair as well as a stretcher. SRWC's as stretchers in the sense it can be used in simple transportation (i.e from consulting rooms to the labs or rooms concerned or to X-ray rooms).Our main objective is to develop a reclining wheelchair which can also be used as an alternative for the stretchers in the hospitals.

I. INTRODUCTION

It is evident from the history that from 600 BC onwards the people were fond of using rolling chairs to transport ones who had walking disabilities and ones who were injured. Almost all civilizations have portrayed the usage of this kind of rolling chairs in their art.

Fig. 1. Ancient wheelchair

Since 1930 there was a huge development in the field of designing the wheelchair. Harry Jennings and Herbert Everest were the two young mechanical engineers who brought the "x-brace" design of collapsing the wheelchair and even now that design is most commonly used. These two engineers saw the business potential of their new invention and they became the first mass manufacturers of wheelchair.

A Power-assisted wheelchair is a recent development that uses the frame & seating of a typical manual chair while replacing the standard rear wheels with wheels that have small battery-powered motors in the hubs. A floating rim design (joystick) senses the pressure applied by the users push & activates the motors proportionately. The ascent in the field of developing the wheelchair is at its peak.

II. OBJECTIVE

- Our main objective is to develop a self-reclining wheelchair that a paraplegic patient can avoid the help of a second person (i.e care giver) to recline the wheelchair and making the person independent on the wheelchair.
- Our another objective is to develop a reclining wheelchair which can also be used as an alternative for the stretchers in the hospitals

A. PARAPLEGIA

Paraplegia is an impairment in motor or sensory function of the lower extremities. It is usually caused by spinal cord injury or a congenital condition such as spina bifida that affects the nueral elements of spinal canal. The area of spinal canal that is affected in paraplegia is either the thoracic, lumbar or sacral regions.

B. QUADRIPLEGIA or TETRAPLEGIA

Tetraplegia is also called as quadriplegia, is paralysis caused by illness to a human that result in the partial or total loss of use of all their limbs and torso: paraplegia is similar but doesn't affect the arms. The loss is usually sensory and motor, which means that both sensation and control are lost. Tetraparesis or quadriparesis, on the other hand, means muscle weakness affecting all four limbs. It may be flaccid or spastic.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

III. PROJECT DESCRIPTION

SELF RECLINING WHEELCHAIR (SRWC) has the reclining backrest and footrest which takes the drive from a rack & pinion mechanism which is placed beneath the seat. The rack is welded to a 19(+.05) mm diameter bush (2 Nos.) and these two bushes run on the shaft of diameter 19mm. The shaft is greased properly to avoid the frictional resistance. The shaft of the pinion wheel is extended to the right hand side, so that the person on the wheelchair can drive the handle using the right hand to control the foot and back rests. In this project we have extended the shaft only to one side since the conditions vary with each patient and the body characteristics of each individual will be unique so whenever developing a wheelchair for a paraplegic patient it should always be a custom made one and the features required in every wheelchair should be according to the need of the patient. So in this case we have developed a general design assuming that the patient has healthy right hand so the question of why not extending the handle to the left side is answered. The shaft is welded to the links connected using bushes which are attached to the back rest and front rest.

A single revolution of the driving handle (i.e. handle attached to the extended shaft of the pinion) can provide the full reclining mechanism as one revolution of the pinion covers the entire length of the rack. The dimensions required to develop the SRWC was obtained by choosing one of the team member randomly and the dimensions were finalized according to his body parameters (i.e randomly chosen team member has an average height and weight as compared to all other team members). The components used for developing the SRWC and the principle on which working takes place are also described in the sections below.

A. Components of a Wheelchair

1) Backrest

This is the main portion of a wheelchair which supports the wheelers to sit upright. The backrest of the basic chair is usually made of a flexible material stretched between the two side frames which are fixed with respect to the seat. The height of the backrest of the adult chair from the seat is 16 - 16 1/2 inches.

2) Leg rest

This is the portion where the legs are given support. There can be two types of leg rest or front rest.

I. Foldable
II. Permanent

These types of leg rests are attached to the wheelchair on the users demand.

3) Arms

The lightest chairs have fixed arms (or none at all), but an overriding factor in wheelchair prescription is to transfer onto and from the wheelchair, especially when the patient is unable to stand upright for a brief period. For this reason, most patients require arms that can be removed easily.

4) Front Rigging

Front rigging is the collective term for footrest and leg rests**.** Footrests consist of a support bracket with swing-away mechanism, and pivot-and-slide-tube to which the footplates are attached

5) Wheels and Tyre

The basic chair has two 24-inch diameter rear wheels and two 8-inch diameter caster wheels in the front **.**Overall length without the front rigging varies between 30 5/8 and 32 inches, depending upon model and manufacturer. The standard rear wheel for many years has been a wire spoke wheel, but wheels of cast metal alloy and wheels of cast plastic have been made available recently to overcome the maintenance problems inherent in the wire wheel design, yet not weigh any more.

6) Hand rims

Hand rims are attached to the driving wheels of wheelchairs to permit control without soiling the hands. The standard hand rim is a circular steel tube. For users who have problems gripping the smooth surface of a metal ring, there are available vinyl coated rings and a variety of knobs and projections that can be added to the ring.

7) Casters

Casters make steering possible and are available in two diameters: 8 inches and 5 inches. Pneumatic, semi-pneumatic, and solid tires are available**.** The 8-inch diameter wheel with solid rubber tires is standard on the basic chair, and is suitable for use on smooth surfaces and indoors. The semi-pneumatic and pneumatic tires provide shock absorption, and, thus, are more suitable for rough surfaces and outdoor use.

8) Parking Locks

Most users need some means of securing one or more wheels to keep the chair from rolling down inclines or to provide stability during transfer to and from the chair. Two types of parking locks are available for the large wheel toggle and lever. Selection depends upon user preference which is usually based on the residual function of the upper limb and hand. These devices are designed and strictly as locks to hold the chair in place and should never be used to slow down a chair because the abrupt stop that would be provided can cause the chair to overturn.

B. COMPONENTS

1) Mechanical Bushes

A mechanical bush is a mechanical fixing between two, possibly moving, parts, or a strengthened fixing point where

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

the connected parts can take sliding motion and translational motion.

Fig. 2. Mechanical bushes

2) GI Pipes

Galvanized Steel are those steel that has been covered with a layer of zinc metal. During galvanizing, steel is immersed in a molten zinc bath, ensuring a tough, uniform barrier coating. Zinc-coated galvanized steel pipes and it resist the attack of wind, water and road salts. Zinc's natural corrosion resistance provides long-term protection, even in outdoor environments. Apart from preventing water corrosion, it is equally effective in dry, indoor environments

GI Pipes are classified into 3 Grades based on their weight per meter and inner diameter thickness. The more the thickness, better the performance and durability. According the IS 1239, each pipe shall bear a color strip across the circumference for identifying the "class" of the GI pipes.

- Light - Class A

These are light gauge pipes which bear a yellow color strip for identification. They are cheaper than other classes of GI Pipes

- Medium- Class B

These are medium gauge pipes which bear a blue color strip for identification. They are Costlier than Class A and Cheaper than class C

- Heavy - Class C

These are heavy gauge pipes which bear a red colour strip for identification. They are Costlier than other classes of the GI Pipes

C. DIMENSIONS OF SRWC

TABLE I

Serial no.	Components	Dimension
1	Height Of Back Rest	75cm
2	Wheel Radius	35cm
3	Height Of Leg Rest	47cm
4	Length Of Seat	52cm
5	Span Of Wheel Chair	70cm
6	Overall Length Of Wheelchair	170cm
7	Diameter Of Addendum Of The Pinion	7cm
8	Diameter Of Dedendum Of The Pinion	6.1cm
9	Tooth Thickness Of Pinion	0.25cm
10	Tooth Space Of The Pinion	0.4cm
11	Tooth Height	0.45cm
12	Tooth Thickness Of Rack	0.4cm
13	Tooth Space Of Rack	0.35cm
14	Tooth Height	0.45cm

IV. WORKING PRINCIPLE

The working principle is based on the simple application of the rack and pinion mechanism, in our day to day life we often depend on this mechanism to lock and unlock the door, or to steer our cars. In our project we have brought the idea of rack and pinion so as to reduce the design complication. On our initial stages of designing we decided to use the worm wheel gear as it provides a self-locking mechanism. On further developing the design we could conclude that by using the worm wheel there are chances that the entire system can be heavy and by consulting with our guide we decided to choose the rack and pinion.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

A. Fundamental law of gearing

In order to have constant angular velocity ratio for all positions of the wheel the point p must be the fixed point (pitch point) for the two wheels. In other words the common normal at the point of contact between a pair of teeth must always pass through the pitch point. This is the fundamental condition which must be satisfied while designing the profiles for the teeth of gear wheels. It is also known as law of gearing.

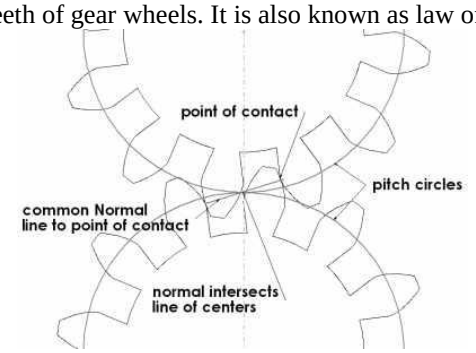

Fig. 3 Schematic representation of fundamental law of gearing

B. Working of the rack and pinion

Rack and pinion mechanism is type of common power transmission mechanism, which has large application in industrial purpose. The pinion takes the power from hand drill which can be rotated by the patient. The pinion and hand drill is connected by means of a shaft. The pinion then transmit power into the rack. The rack slides through bushes, which is welded beneath the seat of SRWC. The rack is connected to the back rest and the foot rest using the turning pair links and this links. Rack and pinion comes under the classification of external gearing in this the pinion and the rack meshes externally with each other as shown in fig.no.3.4. In this the straight line gear is called rack and pinion and it is easier to convert linear motion into rotary motion and vice-versa.

By using helical cut gears we can reduce the noise generated during the working though regularly lubed rack pinion as noiseless and requires less friction. The common application of rack and pinion mechanism can be seen in the door locks where the key acts as the pinion and the lock stud acts as the rack.it has been in practice since years. And another application of the rack and pinion can be seen in the steering mechanism in all the automobiles, for the past one decade the rack and pinion had been replaced by more sophisticated mechanism to reduce the work load on steering.

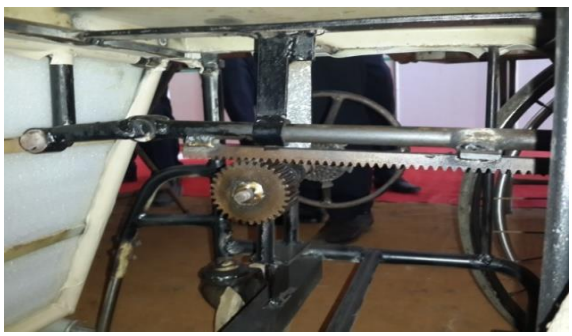

Fig. 4 Rack and pinion

V. CONCLUSION

The aim of making a paraplegic patient completely independent to sleep without displacing oneself to a bed was achieved through developing the self-reclining mechanism.

By conducting this project we dealt with several machines and components required to manufacture the product and we could acquire knowledge about all these and it was helpful. We were able to bring our knowledge to application level so that we could machine our parts in lathe by ourselves. The fabrication of the project follows a trial and hit method where at each stage we had to overcome the mistakes by understanding several tips in fabricating a structure.

From the survey reports we can conclude that the mechanism we developed is useful to the paraplegic patients. The suggestions collected from the care givers from both the surveys, we could deduct that most of the patients take a nap at noon meanwhile the caregivers go outside to fetch things for the home so thereby implementing this mechanism the caregivers shall leave the patients alone at home so that the patients need not require the help of a care giver to lie down and it is one such useful thing to the patients.

ACKNOWLEDGMENT

We express our deep gratitude towards the god almighty for providing this opportunity to complete this paper. We thank all the personal who supported us with their knowledge and experience.

REFERENCES

[1] Birgit Werge,Lise Møldrup, Helle Dreier, Else Marie Hansen,Elisabet Rodby Bousquet, Tilt, Recline, and Elevating Legrests for Wheelchairs "*The 4th International Interdisciplinary Conference on Posture and Wheeled Mobility"*, (2010 June), pp1-20,

[2] William B Mortenson, William C Miller, Jan Miller-Pogar, "*Measuring Wheelchair Intervention Outcomes: Development of the Wheelchair Outcome Measure*, *Am J Phys Med Rehabil".* NIH-PA Author Manuscript, (2007 September), pp1-17

[3] Yih-Kuen Jan, Maria A. Jones, Meheroz H. Rabadi, Amy Thiessen, "*Effect of Wheelchair Tilt-In-Space and Recline Angles on Skin Perfusion Over the Ischial Tuberosity in People With Spinal Cord Injury*, *Am J Phys Med Rehabil".* NIH-PA Author Manuscript, (2010 November), pp1-16

[4] A. Thirugnanam, Praphul das and Lenin Rakesh(2014 August), "*Design and Fabrication of Rack and Pinion Lift"* Middle-East Journal of Scientific Research, pp744-748

[5] G. K. Ananthasuresh, S. N. Kramer (1992 September), *"Kinematic Synthesis and Analysis of the Rack and Pinion Multi- Purpose Mechanism"* pp428-432

[6] R.S.Khurmi, J.K.Gupta, "*Theory of Machines"* ,S Chand's Publications New Delhi,Vol.1,2010.