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Flexible Wheel Chair

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Abstract – Manual wheelchairs are used by people of all ages for a variety of reasons. People may have limited mobility due to poor strength. Endurance or coordination. This may be the result of a specific disability due to the effects of ageing. Furthermore, people may need to use a wheelchair occasionally, temporarily or permanently. This fact sheet discusses some of the important considerations for manual wheelchair selection. A wheelchair must meet the user's individual needs and environmental conditions, provide postural support, and be safe and durable. The wheelchair must be available and affordable and be maintainable and sustainable in the country of use. This is not always easy, because wheelchair users are a diverse group with different requirements and environmental and socioeconomic conditions. The wheelchair is one of the most commonly used assistive devices for enhancing personal mobility, which is a precondition for enjoying human rights and living in dignity and assists people with disabilities to become more productive members of their communities. For many people, an appropriate, well-designed and well-fitted wheelchair can be the first step towards inclusion and participation in society. When the need is not met, people with disabilities are isolated and do not have access to the same opportunities as others within their own communities. Providing wheelchairs that are fit for the purpose not only enhances mobility but begins a process of opening up a world of education, work and social life. The development of national policies and increased training opportunities in the design, production and supply of wheelchairs are essential next steps. Every human being need to move from one place another to fulfill his requirements and to accomplish that requirements he will travel from one place to another place by walking which is a basic medium of transportation. But it is exceptional in case of physically disables (Persons don't have both legs). In order to support and help such a person's we designed a special manually lever operated wheel chair. This wheel chair helps the physically challenged persons to lead their normal life like normal being without the help of any one in their movements from one place to another place and to carry out their work. The wheels are of Special shock absorbing type. This device is designed in such a way that we can use for both indoor and outdoor applications.

Keywords— Wheel Chair, Physically Challenged Person, Indoor and Outdoor Application.

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1. INTRODUCTION

While the needs of many individuals with physical disabilities can be satisfied with wheel chairs. In earlier days the wheel chairs are complicated to operate because they need lot of effort to move them. But in these days while emerging latest technology provides us a power operated wheel chairs and also smart wheel chairs to accomplish the ease of movement of wheel chair.[1]

A wheel chair is a chair fitted with wheels. The device comes in variations allowing either manual propulsion by the seated occupant turning the rear wheels by hand or electric propulsion by motors. There are often handles behind the seat to allow for different individual to push. Wheel chairs are used by people for whom walking is difficult or impossible due to illness, injury or disability. But we consider the aspect of cost incurred in building these wheel chairs is also high. These wheel chairs are costly to build and also very costly to purchase for customers. In order to overcome this cost limitation we designing a special wheel chair with minimal effort to movement and also cost effective. This wheel chair is not power driven but reduces the effort[2][3][8].

We design a wheel chair which suits for both indoor and outdoor conditions. This wheel chair is simple to construct, operate and o repair. It means it is completely cost effective for the people of all classes.

Fig.1 Wheel chair

2. OBJECTIVES

- Wheel chair for Physically Challenged (Don't have both legs) person indoor and outdoor movement applications.
- Locally repairable.
- Hand operated Lever power system to move the wheelchair with chain and sprocket mechanism to reduce the manual effort and speed up to 20km/hr.
- Use of hand lever for each wheel to power up the wheels.
- Mobile shop (movable shop) for self employment of physically challenged person so that he can live independently.

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This device is designed such way that we can use that wheel chair for both indoor and outdoor application. It is manually operated wheel chair which is cost effective. Attendant who push manually wheel chair face difficulties traveling long distance, up slopes, over uneven, and over rough surface. In such conditions the person need help of another person. But we designed such wheel chair it provides independent movement of physically disables and it reduced the efforts involved in moving the wheel chair as compared to common wheel chair[8].

3. COMPONENT EXPLANATION

3.1 COGSET:

Cogset or cluster is the set multiple sprocket that attaches to the hub on the rear Wheel. A cogset works with a rear derailleur to provide multiple gear ratios to the rider. Cogset comes in varieties, cassette or freewheel, of which cassette are a never development. Although cassettes and freewheel perform the same faction and look almost the same when installed, they have important mechanical differences and are not interchangeable.

Fig 3.1 Cogset

3.2 CRANK SET:

The crank set or chin set, is the component of a bicycle drive train that converts the reciprocating motion of the riders legs into rotation motion used to drive the chain or belt, which in turn drive rear wheel. It consists of one or more sprockets, also called chain ring or chin wheel attached to the crank, arms, or crank arms to which the pedals attach. It is connected to the rider by the pedals, to the bicycle frame by the bottom bracket, and to the sprocket, cassette or freewheel via the chin.

Fig 3.2 Crank set

3.3 CHAIN:

A bicycle chain is a roller chain transfer's power from the pedals to the drive wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel plated to prevent rust, or simply for aesthetics. In order to reduce weight, chains have been manufactured with hollow pins and with cut outs in the link. A recent trend is chains of various color, and at least one manufactured offers a chain model specifically for electrically bicycle.

Fig 3.3 Chain

3.4 SPECIAL WHEEL:

It is a small wheel which is placed forefront of the wheelchair. This is fixed to the frame at the top with the help of bearings. Which is made up of cast iron rim with rubber soal is pasted above that. Its main function is give the direction and stability to the wheel chair.

Fig3.4 Wheel

3.5 LEVER:

It is a simple mechanical member that will used to transmit or lift the heavy weight by application of small external force applied on it. may be solid type or hollow type. In this we are using hollow lever which contains brakes and also which are attachable or detachable type in nature.

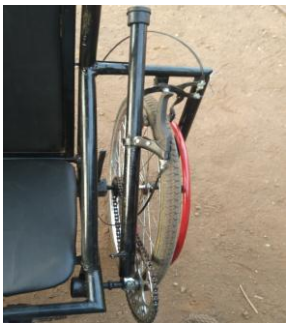

Fig 3.5 Lever

3.6 BRAKES:

This is safety device used to stop, slow down or turn the wheel chair as required conditions. In this we are using normal bicycle brakes which are attached to the rear wheel that will used to stop or slow down the wheel chair.

Fig 3.6 Brake

3.7 WHEELS:

Bicycle suspension helps to insulate rider from the roughness of terrain. Till now fork suspension attached to the steering column is used to save the rider from impact due to irregular terrain. In this project, a research involving the design of wheel that has a spring system between the hub and rim of wheel which provides tangential suspension to the rider from bumps and potholes on the road.

4. DESIGN

4.1 Calculation for torque required

We are assumed some parameters,

Let,

- Weigh of person on wheel chair = 80 kg
- Own weight of the wheel chair = 20 kg

Total weight = 100 kg

Let,

- Minimum velocity, Vmin= 1km/hr= 0.277 m/s
- Maximum velocity, Vmax= 5km/hr= 1.388 m/s

Acceleration a= $\frac{Vmax - Vmin}{\Delta t}$

Where,

= change in time, in seconds

a =

= 0.0740 m/

Acceleration = 0.0740 m/

Now,

Force F= m×a

= 100×9.81×0.0740

F= 72.65N

And,

Torque T= F×R

Where, R= Radius of wheel

T=72.6594×330.2×

T= 23.992 N-m

4.2 Length of lever required to produce the torque

Let,

T= F×L

Where,

L=length of lever

L= 0.611498m

And,

Diameter of the lever = 19.05 mm

4.3 Small Sprocket/ Cogset

- Pitch P= 0.0127 m
- Number of teeth T1 = 28
- Pitch diameter = P/$\sin(\frac{180}{T1})$

= 0.0127/$\sin(\frac{180}{28})$

= 0.11342 m

- Outer diameter = P[0.6+$\cot(\frac{180}{28})$]

= 0.0127[0.6+$\cot 6.43$]

= 0.1203 m

4.4 Larger sprocket

- Pitch P= 0.0127 m
- Number of teeth T2 = 44
- Pitch diameter = P/$\sin(\frac{180}{T2})$

= 0.0127/$\sin(\frac{180}{44})$

= 0.17802 m

- Outer diameter = P[0.6+$\cot(\frac{180}{44})$]

= 0.0127[0.6+$\cot 4.09$]

= 0.18523 m

4.5 Design of chain

- Velocity ratio = $\frac{T2}{T1} = \frac{N1}{N2}$

= $\frac{44}{28}$

= 1.57

- Design power by using service factor = power × Ks

= 0.64 × 1.875

= 1.2kw

- Load on chain

W = $\frac{Rated\ Power}{Pitch\ ine\ velocity} = \frac{0.64}{0.277}$ = 2.31kN

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= 2310N

- Factor of safety = $\frac{WB}{W} = \frac{31.1\times10^3}{2310}$ = 13.46

Calculated value is more than the table i.e 7 hence the design is safe.

- L =KP

K = $\frac{T1+T2}{2} + \frac{2x}{P} + [\frac{T2-T1}{2\pi}]^2 \frac{P}{x}$

= 24 +52.8+0.24586

= 77.04

L = K×P

= 77.04×0.0127

= 0.978 m

4.6 Design of shaft

- Torque transmitted by the shaft = 24 Nm
- Shear stress induced in the shaft τ = $\frac{16T}{\pi d^3}$

τ = $\frac{122215.1496}{d^3}$ N/mm^2

- Compressive stress induced in shaft, σc = $\frac{4F}{\pi d^2}$

= $\frac{499.88}{d^2}$ N/mm^2

- Maximum shear stress,τmax

= $\frac{1}{2}[\sigma c + \sqrt{(\sigma c^2 + 4\tau^2)}]$

= $\frac{1}{2}\{\frac{499.88}{d^2} + \sqrt{(\frac{449.88}{d^2})^2} + \sqrt{4(\frac{122215.15}{d^3})^2}\}$

By the trial and error method, d = 9.9mm = 10mm

Hence we are taken shaft standard diameter = 12mm

5. WORKING PRINCIPLE

Initially the person has to position on the chair. Now he/she has to decide whether the condition is indoor or outdoor. If outdoor then afterwards he had to attach the “special designed front wheel” with the help of locking clamps to the main wheel chair. Next he had to operating the levers by hand. Now by increasing or decreasing the cranking of levers turning effect is obtained according to his/her requirement. Personals can stop or reduce the speed of the vehicle by breaking system while running of tricycle. Afterwards he can use his wheel chair in another condition by detaching the special system for indoor condition. This wheel chair is operated manually. By opening the back seat one can move back up to ground level independently [8].

STEPS:

1. Initially backrest will be unlocked and the physically challenged person move on to the seat.

2. By using lever arrangement he/she will bring backrest to the initial position and lock the backrest by tower bolts.

3. And he can use the wheelchair for indoor/outdoor applications.

STEP 1

STEP 2

STEP 3

6. ADVANTAGES AND DRAWBACKS

6.1 ADVANTAGES

- Physically challenged poor person (Person don't have both legs) has to live independently as a normal person by using this device. He has to use this device for his movement from one place to other both in home and outside of the home (by extra attachments).
- The mobile shop (movable shop) attached to wheelchair has to help the physically challenged person to became self employable.
- The hand powered wheel chair with lever system facilities less stress to person and more speed up as compared to any other wheel chairs available.
- It should economic to poor physically challenged persons.
- It should require less maintenance (as it should not having any electric parts)

6.2 DRAWBACKS

- While engaging lever the reverse motion of the vehicle cannot be achieved.
- Supporting rod may makes noise while obstacles comes in the way.

7. APPLICATIONS

Physically challenged person can use the wheel chair inside the house as well as outside the house.

CONCLUSION

This product is very helpful to physically challenged person don't have both the legs. A novel approach has been made by designing and fabrication an manual lever operated wheelchair that also can be used for both indoor & outdoor applications. This design helps paraplegics who have motor disabilities to move easily and function as an integral part of society. Regular wheelchairs and three wheelers are separate units and can never be used in conjunction. The three wheelers available in the market currently come at high cost and they restricted to outdoor use. The cost of wheelchair is also significantly lower than any electrical wheelchairs currently available in the market. The low cost helps paraplegics who are a part of the lower class of society to function better as it does not only help in moving indoors but also on the road. This wheel chair is operated manually. By opening the back seat one can move back up to ground level independently.

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