International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 6 ǁ 2022 ǁ PP. 1380-1384

Design and fabrication of 90 degree steering wheel mechanism

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Abstract *- A new absolute eco-friendly vehicle with independent, low emission transportation possible for people who utilize wheelchair could definitely be an improvement in this system. For this, an eco-friendly vehicle, like an electric car which can steer through 90 degrees, thus reducing the turning radius with low efforts has to be defined. Automotive of present time does not have the ability to steer through 90 degrees. Such vehicles can help disabled people effectively. A lot of researches have been done on this field so as to implement this methodology but it has not yet been implemented. The idea is to use electric motors on any two diagonal wheels and a counter phase system implementation. The mechanism works at low speed only. Advantages of this system is that it can work in limited space and it reduces the time and effort for steering through 90 degrees thus making the system more flexible. It can be used for other applications such as parking, farm vehicles, trucks, forklifts etc.*

Key Words: *(90 degree mechanism, Eco-friendly, Steering gear, Parallel parking)*

Date of Submission: 07-06-2022 Date of acceptance: 22-06-2022

I. INTRODUCTION

90 degree steering mechanism basically helps to reduce the efforts and space required for a person to steer his vehicle. This 90 degree mechanism can be implemented in vehicles that can be designed especially for the disabled, for whom, simple vehicle designs are necessary.

In the current scenario, the vehicles that the disabled use are simply the same ones that normal people use, with some basic attachments such as side wheel attachments used in scooters. The major problems in these systems are Large turning radius, large effort and not ecofriendly.

To account for the difficulties mentioned above, A new absolute eco-friendly vehicle with independent, low emission transportation possible for people who utilize wheel chair could definitely be an improvement in this system.

For this, an ecofriendly vehicle, like an electric car which can steer through 90 degrees thus reducing the turning radius with low efforts has to be designed. The basic requirement of this car is that it, Steers through 90 degree, Runs on electric motor thus reducing emissions
A slope for entry on the rear end.

1.1 Steering System Gear Mechanisms

There are two types of Steering gear mechanism

- Fifth wheel steering system
- Side pivot steering system

Fifth wheel steering system:

It is single pivot steering system in which the front axle along with the wheels, moves to right or left. The movement to the whole axle and wheel assembly is affected by means of a steering and a wheel which is placed between chassis frame and axle. The fifth wheel acts as a turntable. The axle assembly is connected with the frame by means of a pin which serves as a pivot around which the axle assembly moves. The fifth wheel contains a ring gear mounted at its rim and is moved by means of a steering. Movement of the steering wheel tends the front axle and wheel assembly to move away.

Side pivot steering mechanism:

1. Davis steering gear mechanism
2. Ackerman steering gear mechanism

The main difference between the two steering gear mechanisms is that the Davis steering has sliding pairs, whereas the Ackermann steering has only turning pairs. The sliding pair has more friction than the turning pair; therefore the Davis steering gear will wear out earlier and become inaccurate after certain time. The Ackermann steering gear is not mathematically accurate except in three positions, contrary to the Davis steering gear which is mathematically correct in all positions. However, the Ackermann steering gear is preferred to the Davis steering gear.

Davis Steering Gear:
The Davis Steering gear has sliding pair, it has more friction than the turning pair, therefore the Davis Steering Gear wear out earlier and become inaccurate after certain time. This type is mathematically accurate.

Davis Steering System

The Davis gear mechanism consists of a cross link KL sliding parallel to another link AB and is connected to the stub axles of the two front wheels by means of two similar bell crank levers ACK and DBK pivoted at A and B respectively. The cross link KL slides in slides in the bearing and carries pins at its end K and L. The slide blocks are pivoted on these pins and move with the turning of bell crank levers as the steering wheel is when the vehicle is running straight, the gear said to in its mid-position. The short arms AK and BL are inclined an angle 90+alpha to their stub axles AC and BD. The correct steering depends upon a suitab1e selection of cross-arm angle alpha, and is given by

$$\tan(\text{alpha}) = b / 2l$$

Where b=AB=distance between the pivots of front axles. , l=wheel base.
The range of b / l is 0.4 to 0.5 hence angle alpha lies between 11.3 and 14.10.

Ackermann Steering Gear
Ackermann Steering Gear has only turning pair. It is not mathematically accurate except in three positions. The track arms are made inclined so that if the axles are extended they will meet on the longitudinal axis of the car near rear axle. This system is called Ackermann steering.
The Ackermann steering gear mechanism consists of a cross link KL connected to the short axles AC and BD of the two front wheels through the short arms AK and BL, forming bell crank levers CAK and DBL respectively. When the vehicle is running straight, the crosslink KL is parallel to AB, the short arm AK and BL both make angle alpha to the horizontal axis of chassis. In order to satisfy the fundamental equation for correct steering, the links AK and KL are suitably proportioned and angle alpha is suitably selected. For correct steering

$$\cot(\text{phi}) - \cot(\text{theta}) = b / l$$

Ackermann Steering Gear
The angles (ph)i and (theta) are shown in the Figure. The value of b / l is between 0.4 and 0.5, generally 0.455. The value of cot (phi) – cot (theta) corresponds to the positions when the steering is correct. In fact there are three values of angle(theta) which give correct steering of the vehicle: first while it is turning to right, second while it is turning to left and third while it is running straight.

1.2 Objectives
The aim is development of the specifications of the original 90 degree turning wheels for transverse parking project are outlined in this chapter. The development of suitable goals and specifications were crucial to the project's success as they guided both the design and aims of the project team. As part of the requirements of the project a number of goals were established to measure the success of the project. The primary goals were defined as the goals the group hoped to achieve a minimum for success. The main objectives of the project are
- Better parking at home in narrow space and at multiplexes
- This type of car can be taken through traffic jam
- Car can be move easily
- Use of electrical drives to optimize power consumption.
- Maintenance is low.

II. Functions of the components

2.1 Chassis

Aluminum (aluminum in American and Canadian English) is a chemical element with the symbol Al and atomic number 13. It is a silvery-white, soft, non-magnetic and ductile metal in the boron group. By mass, aluminum makes up about 8% of the Earth's crust, where it is the third most abundant element (after oxygen and silicon) and also the most abundant metal. Occurrence of aluminum decreases in the Earth's mantle below, however. The chief ore of aluminum is bauxite. Aluminum metal is highly reactive, such that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different minerals.

Aluminum is remarkable for its low density and its ability to resist corrosion through the phenomenon of passivation. Aluminum and its alloys are vital to the aerospace industry and important in transportation and building industries, such as building facades and window frames.[The oxides and sulfates are the most useful compounds of aluminum.

2.2 Bearing

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction.

2.3 Pulley

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain.

2.4 Rubber belt

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points. The belt drive can also be used to change the speed of rotation, either up or down, by using different sized pulleys.

2.5 Dc Motor

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

2.6 DC Power Supply

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars.
When a battery is supplying electric power its positive terminal is the cathode and its negative terminal is an anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit that will flow through an external electric circuit to the positive terminal.

III. 90 degree steering wheel mechanism

Figure show the fabrication of 90 degree wheel steering mechanism. In this project battery provides power supply to the control unit. The equipment contains six motors, two motors coupled with the vehicles left and two motors coupled with the right side of the front wheel, the next two are coupled to the vehicles left and right side of the back side.

The four motors are used to run the vehicle. Another two motors are connected to rotate the vehicle wheel 90 degree by the chain drive arrangements and all the motors are controlled by two way switches. Four wheel are connected to the DC motors and they controlled by switch this switch having the control of forward and backward of wheel. The four L angel plate is used to fix the motors and they connected to shafts. In the shaft 6 pulleys mounted they are helps to shaft rotates. Pulleys are connected with belts as show in figure.

Two motors are connected to the shaft. When motor operates shafts are rotates then wheel rotates 90 degree as similarly another motor operates other wheels turns to 90 degree.

The front wheels as well as the rear wheel are positioned as parallel to each other which are normal in condition before operation. Left and right switch of the control switches are used to turn the vehicle wheels left and right respectively. Where the third key is operates front wheels which are parallel to rear wheel and makes an angle of 90 degrees to normal wheel system. In this position we directly turn the vehicle without any turning radius.

IV. CONCLUSIONS

As per the objectives of the project , created an innovative 4 wheel 90 degree steering mechanism which is feasible to manufacture, easy to install and highly efficient in achieving 90 degree steering for vehicles. This system assists in parallel parking of vehicles. It combats the problems faced during the parking in constrained parking spaces. It reduces the turning circle radius of the car and gives better maneuverability and control while parking. Moreover components used in this system are easy to manufacture, material used is feasible, reliable and easily available in market. The system assembly is easy to install and light in weight and can be implemented in all sections of cars efficiently.

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