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CONVERTABLE FOUR WHEELS STEERING WITH THREE MODE OPERATION

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Abstract

The most conventional and general steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the Driver. The steering column, which contain an universal joint which is part of the collapsible steering column which is designed to allow it to deviate from a straight line according to the Roadmap.

In CONVERTIBLE FOUR WHEEL STEERING WITH THREE MODE OPERATION three steering modes can be changed as needed which assists in parking at heavy traffic conditions, when negotiating areas where short turning radius is needed and in off road Driving.

Key Words: Steering; Wheels, steering column; Universal joint.

1. Introduction

Steering is the term applied to the collection of components, linkages, which will allow for a vessel or vehicle to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function.

The most conventional steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver, through the steering column , which may contain universal joints to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear–wheel steering. Tracked vehicles such as tanks usually employ differential steering that is, the tracks are made to move at different speeds or even in opposite directions to bring about a change of course.

2. RACK AND PINION

A rack is a toothed bar or rod that can be thought of as a sector gear with an infinitely large radius of curvature. Torque can be converted to linear force by meshing a rack with a pinion: the pinion turns; the rack

moves in a straight line. Such a mechanism is used in automobiles to convert the rotation of the steering wheel into the left-to-right motion of the tie rod(s). Racks also feature in the theory of gear geometry, where, for instance, the tooth shape of an interchangeable set of gears may be specified for the rack (infinite radius), and the tooth shapes for gears of particular actual radii then derived from that. The rack and pinion gear type is employed in a rack railway.

A rack and pinion is a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a flat bar - the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. The pinion is in mesh with a rack. The circular motion of the pinion is transferred into the linear rack movement.

3. BEVEL GEAR

Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone.

3.1 STRAIGHT BEVEL GEAR

Straight bevel gears are used for transmitting power between intersecting shafts. They can operate under high speeds and high loads. Their precision rating is fair to good. They are suitable for 1:1 and higher velocity ratios and for right-angle meshes to any other angles. Their good choice is for right angle drive of particularly low ratios. However, complicated both form and fabrication limits achievement of precision. They should be located at one of the less critical meshes of the train. Wide applications of the straight bevel drives are in automotive differentials, right angle drives of blenders and conveyors.

3.2 SPIRAL BEVEL GEAR

Spiral bevel gears are also used for transmitting power between intersecting shafts. Because of the spiral tooth, the contact length is more and contact ratio is more. They operate smoother than straight bevel gears and have higher load capacity. But, their efficiency is slightly lower than straight bevel gear.

3.3 HYPOIDAL BEVEL GEAR

These gears are also used for right angle drive in which the axes do not intersect. This permits the lowering of the pinion axis which is an added advantage in automobile in avoiding hump inside the automobile drive line power transmission. However, the non –intersection introduces a considerable amount of sliding and the drive requires good lubrication to reduce the friction and wear. Their efficiency is lower than other two types of bevel gears. These gears are widely used in current day automobile drive line power transmission.

4. STEERING SYSTEM

The steering system is to achieve angular motion of the front wheels to negotiate a turn. This is done through linkage and steering gear which convert the rotary motion of the steering wheel into angular motion of the front road wheels.

Secondary functions of the steering system are:

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- To provide directional stability of the vehicle when going straight ahead.
- To provide perfect steering condition, perfect rolling motion of the road wheels at all time.
- To facilitate straight ahead recovery after completing a turn. To minimize tire wear.

Till recently all vehicles were steered by turning the front wheels in the desired direction, with the rear wheels following. However, lately all-wheel-steering has been designed and employed in some selected vehicles.

5. COMPONENTS

The four wheel steering with three mode operation consists of the following components to full fill the requirements of complete operation of the machine.

- Rack and pinion
- Bevel gear
- spur gear
- Steering
- Wheel
- Hinge joint

5.1 DESIGN OF THE STEERING SYSTEM

TOP VIEW

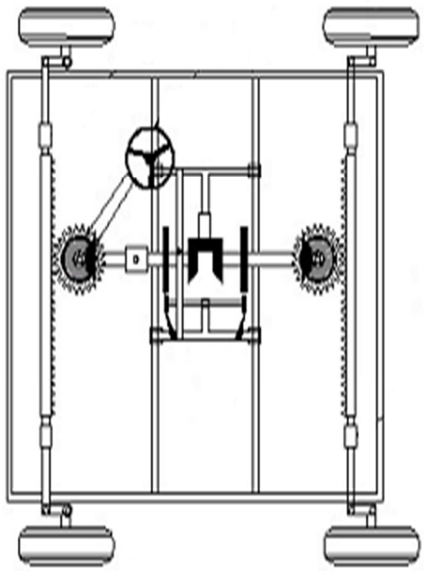


Fig 5.1

SIDE VIEW

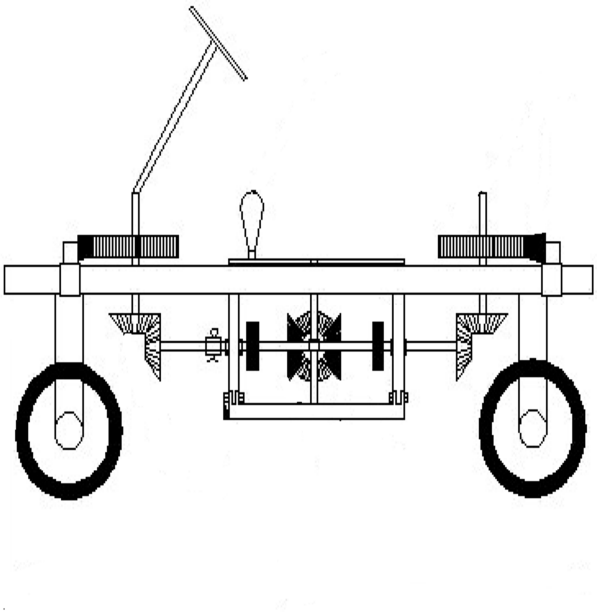
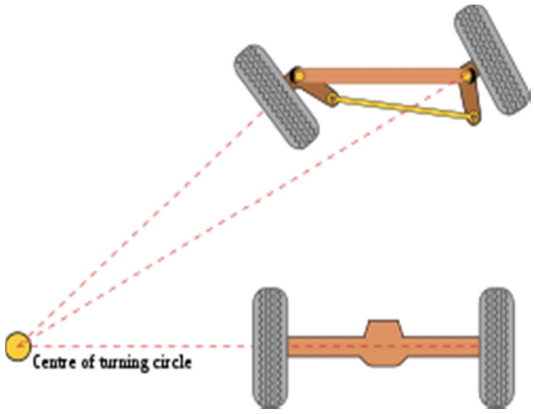


Fig 5.2

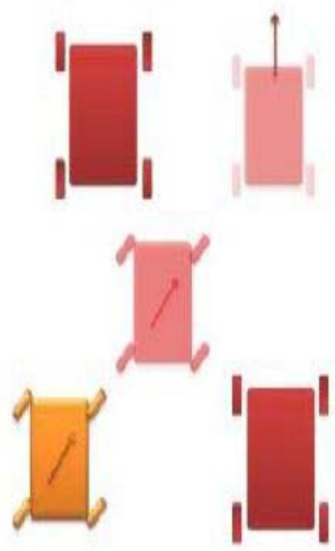
6. WORKING PRINCIPLE

Our project consists of a steering setup, spur gears, bevel gears and lock nut. The three modes are,

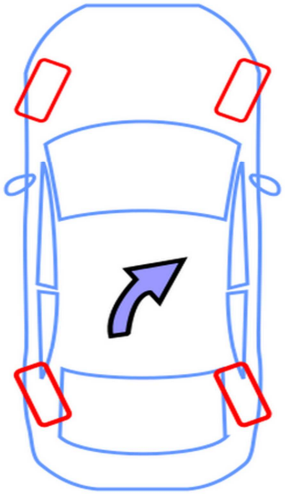
1. Front wheel steer



2. Both front and rear wheel steer in same direction



3. Both wheels in opposite direction



When the lock nut is removed, the steering operation is carried out in normal condition. That is only front wheels steer. But when the lock nut is inserted, the other two modes can be used. When the gear arrangement is pushed to one position, the spur gears get engaged and the steering of rear wheel is ensured and is in same direction as that of the front wheels. When the gear arrangement is moved to other side, the spur gear disengages and the bevel gear gets engaged. Due to bevel gear arrangement, the rear wheel steers in opposite direction to the front wheel. This results in third mode steering.

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6.1 WORKING PRINCIPLE OF THREE MODE STEERING

1st mode operation

When the lock nut is removed, the steering operation is carried out in normal condition. That is only front wheels steer. Fig 6.1 show the first mode operation.

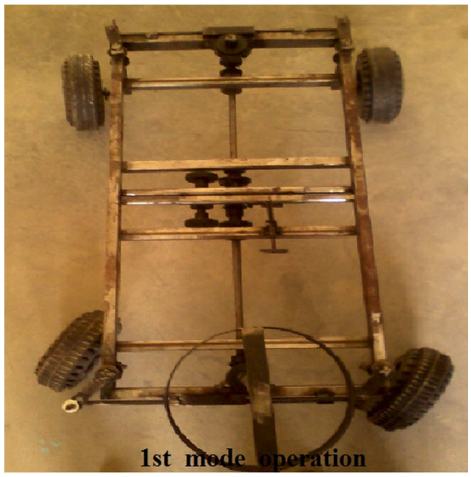

Fig 6.1 first mode operation

2nd mode operation

In 2nd mode operation when the lock nut is inserted, the other two modes can be used. When the gear arrangement is pushed to one position, the bevel gears get engaged and the steering of rear wheel is ensured and is in same direction as that of the front wheels. Fig 6.2 shows the second mode operation.

Fig 6.2 second mode operation

3rd mode operations

When the gear arrangement is moved to other side, the bevel gear disengages and the bevel gear gets engaged. Due to spur gear arrangement, the rear wheel steers in opposite direction to the front wheel. This results in third mode steering.

Three steering modes can be changed as needed which assists in parking at heavy traffic conditions, when negotiating areas where short turning radius is needed and in off road Driving. Fig 6.3 shows the 3rd mode operation.

Fig 6.3 third mode operation

7. LIST OF MATERIALS

7.1 FACTORS DETERMINING THE CHOICE OF MATERIALS

The various factors which determine the choice of material are discussed below.

1. Properties:

The material selected must posses the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection

a. Physical
b. Mechanical

c. From manufacturing point of view
d. Chemical

The various physical properties concerned are melting point, thermalConductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties Concerned are strength in tensile,Compressive shear, bending, torsion and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are,

- Cast ability
- Weld ability
- Surface properties
- Shrinkage

2. Manufacturing case:

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

3. Quality Required:

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

4. Availability of Material:

Some materials may be scarce or in short supply. It then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. the delivery of materials and the delivery date of product should also be kept in mind.

5. Space consideration:

Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

6. Cost:

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored.

Some times factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

8. ADVANATAGES

1. Easy maintenance.

2. Mode change is easy.

3. Implementation is easy.

9. APPLICATIONS

- Used for easy parking in four wheelers
- It is applicable for all four wheeled vehicles.

10. CONCLUSION

The project carried out by us made an impressing task in the field of automobile industries. It is very usefully for driver while driving the vehicle.

This project has also reduced the cost involved in the concern. Project has been designed to perform the entire requirement task which has also been provided.

11. REFERENCES

[1].Unknown, Four wheel steering report, http://www.scribd.com/doc/34677964/Four-Wheel-Steering-report, Retrieved on 13th Sep 2012.

[2].Unknown, Four wheel steering, http://www.wisegeek.com/what-is-four-wheel_steering.htm, Retrieved on 13th Sep 2012.

[3].Unknown, Four wheel steering, http://what-whenhow.com/automobile/four-wheel-steering-4wsautomobile/, Retrived on 14th Sep 2012.

[4]. "Honda Prelude Si 4WS: It Will Never Steer You Wrong," Car and Driver, Vol. 33, No. 2, pps. 40-45, August 1987.

[5]. Sano s et al, "Operational and design features of the steer angle dependent four wheel steering system." 11th International conference on Experimental safety vehicles, Washington D C1988, 5P.

[6].Jack Erjavec., *Automotive Technology, A System Approach*, 5th Edition, 2010.

[7].Farrokhi, Four wheel steering, http://www.iust.ac.ir/files/ee/farrokhi_0a5f0/journal_papers/j13.pdf, Retrieved on 20th Oct 2012.

[8].M. Abe, "Vehicle Dynamics and Control for Improving Handling and Active Safety: From Four-Wheel-Steering to Direct Yaw Moment Control," in *Proc. Institution of Mechanical Engineers*, Part *K, Journal of Milti-bodyDynamics*, vol. 213, no. 4, 1999.

[9]. Lee, A.Y., "Vehicle Stability Augmentation Systems Designs for Four Wheel Steering Vehicles," ASME Journal of Dynamical Systems, Measurements and Control, Vol. 112, No. 3, pps.489-495, September 1990.