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Review of 4WS In Multimode Operation

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Abstract **- This paper gives the information about Design of Multimode Four Wheel Steering. It is very difficult for a medium size sedan to take a U-turn on a busy road with the little space available for the vehicle to actually make the turn. It is also difficult for the driver to take the vehicle a little backward and then make the turn as the roads are busy and small. In such a case, if the vehicle is equipped with four wheel steering system, it will be easy for the driver to actually make the turn with ease even in the small space that is available for him. But the main thing is that we have two configurations in four wheel steering systems called same phase and opposite phase. The main intension of this paper is to reduce the turning radius of a vehicle as much as practically possible without crossing the practical limits of design and assembly of the components of the steering system.**

Index terms **-** Steering gearbox, Linkages, Steering bar, Steering Wheel, Wheels, wheels hub, Rectangular Iron frame.

I. 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.

A. Conventional Steering System

Usually during the steering of the vehicle, only the front wheels are steered towards right or left according to the requirement and the rear wheels are mere followers of the front wheels in this system. This is taken as mode –I.

B. Four Wheel Steering System

The direction of steering of rear wheels relative to front wheels depends on the operating conditions. At low-speed wheel movement is pronounced, so that rear wheels are steered in the opposite direction to that of front wheels. This also simplifies the positioning of the car in situations such as parking in a confined space. Since the rear wheels are made to follow the path on the road taken by the front wheels, the rear of a 4 WS car does not turn in the normal way. Therefore the risk of hitting an obstacle is greatly reduced. In a 4WS system, the control of drive angle at front and rear wheels is most essential. A 4WS system can be used in various applications are as follows:

a) Parallel parking: During a parking a vehicles driver typically turns the steering wheels through a large angle to achieve a small turning radius. By counter phase steering of the rear wheels, 4WS system realizes a smaller turning radius than is possible with 2WS system. As a result vehicle is turned in small radius at parking.

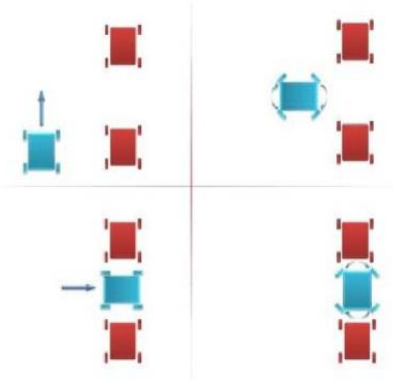

Figure1. Parallel parking

b) At Junctions: On a cross roads or other junction where roads intersect at 90 degrees or tighter angles, counter phase steering of the rear wheels causes the front and rear wheels to follow more or less path. As a result the vehicle can be turned easily at a junction.

c) Slippery road surfaces: During steering operation on low friction surfaces, steering of wheels suppress sideways drift of the vehicle's rear end. As a result the vehicles direction is easier to control.

d) High speed straight line operation: When traveling in a straight line at high speed, a vehicle's driver frequently needs to make small steering correction to maintain the desired direction; in phase steering of the rear wheels minimizes these corrective steering inputs.

e) Narrow roads: On narrow roads with tight bends, counter-phase steering of the rear wheels minimizes the vehicle's turning radius, thereby reducing side-to –side rotation of the steering wheels and making the vehicle easier to turn.

f) U-Turns: By minimizing the vehicle's turning radius, counter –phase steering of the rear wheels enables U-turns to be performed easily on narrow roads.

II. WORKING PRINCIPLE AND MECHANISM OF 3MODE 4WS

A. Normal Mode

In this drive only the front axle moves either in clockwise or anticlockwise direction and the rear wheel being unmoved. This is the drive that we see in day to day life in the four wheelers. It is generally used at moderate speed.

The working of our model is as that of normal automobile system. The front wheels are in working condition and rear wheels are in fixed position about their axis which just moves forward with the help of lock nut. Front wheels move front, left and right sideways and rear wheels follow them.

Figure 2. Mode 1- Normal Mode

B. Reducing Radius Mode

In this drive the axles both the front and the rear move in opposite direction relative to each other. This drive is mainly used during parking of the vehicle. As both the axle move in opposite directions the radius of curvature while turning reduces. This means the vehicle will require less space for parking and this will be helpful in places where traffic and parking is a major problem.

The working of front steering mechanism is same as that of in mode-I. The only change is in rear steering mechanism. The reverse mechanism is kept activated and lock nut is disengaged which was kept engaged in mode -I. The reverse mechanism is attached to rear steering mechanism which causes the rear wheels to move in opposite direction as that of front wheels.

Figure 3. Mode 2- Reducing radius mode

C. 360˚ Mode

In mode III, for front and rear steering the guide plate is fixed with middle link with the help of pin which is inserted in the slot providing on the guide plate and middle link, causing the guide plate to just rotate about its axis.

The lock nut is kept engaged with reverse mechanism. And due to all this engagement, all the four wheels get deflected about 60˚ causing complete 360˚ rotation.

Figure 4. Mode 3- 360˚ mode

III. FACTORS DETERMINING THE CHOICE OF MATERIALS

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

A. Properties

The material selected must possess 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. From manufacturing point of view
d. Chemical

The various physical properties concerned are melting point, thermal Conductivity, 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

B. Manufacturing cost or surface qualities

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.

C. 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.

D. 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.

E. Space consideration

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

F. Cost

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored. Sometimes factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

IV. ADVANTAGES OF 4WS SYSTEM

The following advantages of 4WS system will be encounter for the practical application.

1. Superior cornering stability: The vehicle cornering behavior becomes more stable and controllable at high speed as well as on wet slipper road surfaces.
2. Improved steering response and precision: The vehicle response to steering input becomes quicker and more precise throughout the vehicle enter speed range.
3. Smaller turning radius: By steering the rear wheels in the duration opposite the front wheels at low speed, the vehicle's turning circle is greatly reduced. Therefore, vehicle maneuvering on narrow roads and during parking become easier.
4. Controlling: Computer-controlled Quadra steer can be switched on and off and has an effective trailer towing mode.

IV. CONCLUSIONS AND FUTURE SCOPE

Thus the four-wheel steering system has got cornering capability, steering response, straight-line stability. Even though it is advantageous over the conventional two-wheel steering system, 3Mode 4WS is complex and expensive.

Currently the cost of a vehicle with 3Mode 4WS is more than that for a vehicle with the conventional two wheel steering. On large scale industrial production we can reduce the cost of this system. The rapid increasing in number of vehicles on road day by day, demands an exploration of such mechanism to reduce driver's effort and get rid of from the huge traffic. If an electronic and hydraulic assistance is given to 3Mode 4WS system, it will reduce the complexity and helps in better handling. Introduction of sensors and hydraulic actuators instead of the pure mechanical system used in the project will make the vehicle more stable and efficient. Also the introduction of 360 turn to the front and rear wheels helps the vehicle to rotate its own axis, by this method vehicle can be moved easily from the parking easily. All the modes i.e. reducing radius mode, normal mode and the 360 turning of the vehicle can be more accurate and efficient with the help of hydraulic/pneumatic actuators and sensors. The above mentioned modes will help to control the vehicle more easily in every situation.

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