Appraise of Recent Development and Innovation in Four Wheel Steering System

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Abstract **-** In urban life, the driving conditions of the vehicle with higher Wheelbase and track width face problems of turning as space is confined, the same problem is faced in low speed cornering Four wheel steering is a method developed in the automobile industry for the effective turning of the vehicle and to increase the maneuverability. In recent times, there is continuous need and demand for a car to attain flexibility. For a vehicle, working on all wheel drive (AWD) then it becomes easy to achieve adjustability. With this stability, handling and control the minimum speed achieved is till 10 kmph. The main aim is to improve steering response, increase vehicle adjustability while maneuvering at high speed and to decrease turning radius at low speed.

Keywords: *Maneuverability, Turning radius, four wheel steering, Stability, Oversteer, and understeer*

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1. INTRODUCTION

Steering is the mechanism by which the user can control the direction of travel of the vehicle. It enables the vehicle to follow the desired course. The aim of this paper is to study the recent steering system being used in four wheelers. The four wheel steering is used to decrease the turning radius of the vehicle as compared to the conventional steering mechanism. The conventional steering mechanism involves the use of Ackerman and Davis steering. Using these steering systems the main disadvantage is that it's more. For eliminating this, it is suggested to employ four-wheel steering system. This helps in turning the vehicle in tight spaces such as parking lots. Theflexibility of the turning radius of wheel can be achieved only at low speed. At high speed, the front wheel and the back wheel turn in the same direction as it facilitates lane changing. A front wheel does most of the steering while the rear wheel's turning is limited to half during an opposite direction.

2. RECENT STEERING MECHANISMS FOR FOUR WHEELER

2.1 Crab steering:

It was developed in 1990's, along with four wheel steering. With Crab steering, the wheels can turn in the same direction by the same amount so that the vehicle can move sideways. [6] It is mainly used in construction equipment such as backhoes and forklifts. This is especially helpful in tight quarters on the job, where there is not enough space to move a conventional forklift back and forth several times in order to line up at the exact spot in front of the loading location. [2]

Fig. 2.1

2.2 Articulated steering:

Articulated steering separates the vehicle into two sections, a front, and a back half with the pivot point directly in the middle. Structurally, the articulation joint allows the front frame turning at an angle relative to the rear frame in the horizontal plane to achieve the steering function. Thehydraulic piston moves the front or the back section about the pivot point directly in the middle of the vehicle. Since the entire body rotates along with the front wheel, the load on the front axle is reduced and can take heavier loads. Because they are mobile, flexible, versatile, economic, they are used widely in the forestry, construction, agriculture, and mining industries. [1]

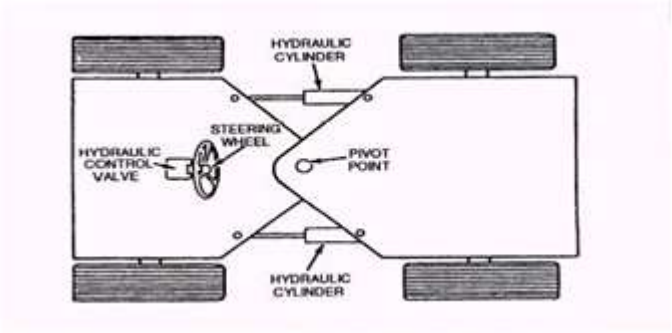

Fig. 2

2.3 Rear wheel steering:

A few types of vehicle use only rear wheel steering, notably fork lift trucks, camera dollies, early pay loaders, Buckminster Fuller's Dymaxion car, and the Thrust SSC. Rear wheel steering swings the rear wheels outside of the front wheel tracks. The principle advantage is greater effectiveness in handling off-center loads at either front or rear. This type of steering is used with front-end loaders, as they need to move to turn the cargo in the tightest radius. [4] As mentioned above, rear wheel steering can offer smaller, sharper angle of rotation compared to front wheel steering. It is also used in various long goods vehicles, and since these vehicles seldom go at high speeds, they can make the most of the rear wheel steering system. Rear wheel steering is also be found in motorsports, where drifting is encouraged i.e. the rear wheels swing outside the front wheels. Although the degree to which the wheels turn is less than the front wheels.

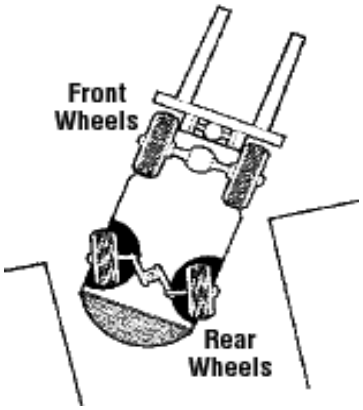

Fig.2.3

2.4. Passive rear wheel steering:

Many modern vehicles offer a form of rear wheel steering known as passive rear wheel steering to counteract normal vehicle tendency to toe in. In many vehicles, when cornering, the rear wheels tend to slightly steer to the outside of a turn, which can reduce stability. [2]

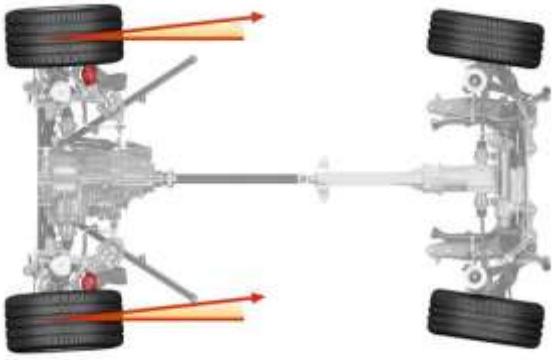

Fig.2.4

2.5 Active four wheel steering:

In active four-wheel steering, both front and rear wheels can be steered according to the speed of the vehicle and space available for turning. In most active four-wheel steering, the rear wheels are steered by a computer and an actuator. The rear wheels cannot generally steer as much as front wheels. Conventional two wheel steering cars tend to understeer or, in few instances oversteer. Using 4WS, the car can automatically compensate for an understeer or oversteer problem. It improves handling and helps the vehicle make tighter turns. However, only a few car manufacturers provide the option for a 4WS system, manufacturers like Honda, which provided a four-wheel steering option in their Honda Prelude and, other companies like Mazda, General Motors, Nissan, and Renault. However the main aim of these systems was to assist front wheels in steering and not steering itself, and thus the rear wheels could only turn two to three degrees. [3][4]

2.5.1 Working of an Active Four wheel steering system:

Four wheel steer steering system works differently during different speed limits. Depending on the speed of the car, the rear wheels may turn in the opposite direction, also known as counter steering, or turn in the same direction, called same-side steering. The operation of this system shows below:

2.5.1.1 Low-speed Operation:

At low speeds of about 10 to 40 km/h, the rear wheels move in opposite direction to the front wheels. This is also known as counter-steering. In conventional, two wheel steering during turning, the front wheels immediately begin to pivot and the vehicle's forward momentum generates a powerful cornering force. The rear wheels, however, take time to generate a corresponding force at the rear end of the vehicle. [2] This is the reason the rear end of a car lags behind the front end. In extreme cases, this lag may cause the car to oversteer and spiral out of control. But in four wheel steering, at low speeds counter steering helps the driver to make sharper turns and reducing the turning radius by up to

40% [4]. This is especially useful in metro cities, where maneuvering is difficult

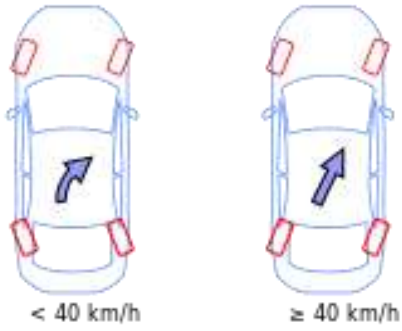

Fig. 2.5

2.5.1.2 High-speed operation:

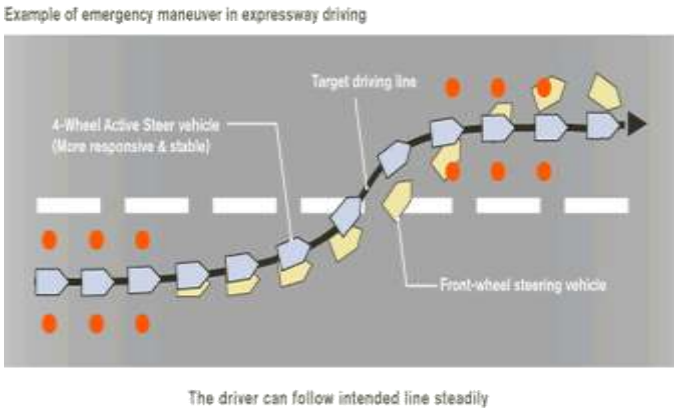

Fig. 2.6: More responsiveness and stability of four-wheel steering

Counter steering at high speeds can make the vehicle unstable. To put simply, counter steering at high speeds would result in an extreme case of oversteer where the rear end is pushed away from the center of rotation of the vehicle making the car more unstable. Same side steering, however, improves the steering performance of the vehicle by eliminating the high-speed sway which is observed in two-wheel steering system. This is done by producing cornering forces on the front and the rear axles simultaneously to eliminate the rear end lag. [2]. However, the degree to which the rear wheels turn with the front wheels depends on the speed of the vehicle. Wheels turn at a lesser angle between speeds of 40 km/h to 80 km/h than at speeds more than 80 km/h.

3. CONCLUSION:

The study of various four wheel steering system shows that the maneuverability of the vehicle greatly increases at low as well as high speeds. By using electronic steering the steering response can be further improved. The different types of four wheel steering perform their functions effectively, such as the crab steering improves maneuverability in cramped spaces, active four wheel steering improves handling of cars at various speeds and eliminates oversteer and articulated steering reduces effort and improves cornering of segmented vehicles. However, that being said, the four wheel steering system is complex and its implementation is expensive and is yet to be available in all markets. But given the recent advancements in the automobile industry, it is safe to assume that the system will become more commonplace.

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