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Design & Fabrication of Four-Wheel Steering System

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ABSTRACT - In the growing world, automobiles play a vital role In our lives. Our main motive here is to bring in the use of 4- wheel steering (All wheel steering) into common usage among car companies due to increase in traffics and congestions. Four wheel steering is preferable than two wheel steering systems because a multi-function four wheel steering system could improve directional stability at high speeds, sharp turning performance at low speeds, and parking performance of a vehicle. Once this concept come into use parking becomes very easy and driving in sharp turns make it much easier. Production cars are designed to understeer and rarely do they oversteer. If a car could automatically compensate for an understeer/oversteer problem, the driver would enjoy nearly neutral steering under varying operating conditions.

Four- wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. Also in situations like low speed cornering, vehicle parking and driving in city conditions with heavy traffic in tight spaces, driving would be very difficult due to vehicle's larger wheelbase and track width. Hence there is a requirement of a mechanism which result in less turning radius and it can be achieved by implementing four wheel steering mechanism instead of regular two wheel steering.While braking, a large amount of energy is lost in the form of heat. A regenerative braking system aims to utilize this energy instead of getting it wasted

1. INTRODUCTION

Steering is the term applied to the collection of components, linkages, etc. which will allow a vessel (ship, boat) or vehicle (car, motorcycle and bicyeles) to follow the desired course. Four wheel steering, 4WS, also called rear-wheel steering or all-wheel steering, provides a means to actively steer the rear wheels .

during turning maneuvers.energy Four wheel steering is a method developed in automobile industry for the effective turning of the vehicle, increase the maneuvembility and reduce the drivers steering effort. In city driving conditions, the vehicle with higher track width and wheelbase face problems of turning as the space is confined the same problem is faced in low speed cornering.

The turning radius is reduced in the four wheel steering of the vehicle which is effective in confined space, in this project turning radius is reduced without changing the dimension of the vehicles.

In situati19ons like vehicle parking, low speed comering and driving in city conditions with heavy traffic in tight spaces, driving is very diffieult due to vehicle's larger track width and wheelbase. When both the front and rear wheels steer toward the same direction, they are said to be in-phase and this produces a kind of sideways movement of the car at low speeds. When the front and rear wheels are steered in opposite direction, this is called anti-phase, counter-phase or opposite-phase and it produces a sharper, tighter turn.

Fig. 3– Concept Model

2. LITERATURESURVEY

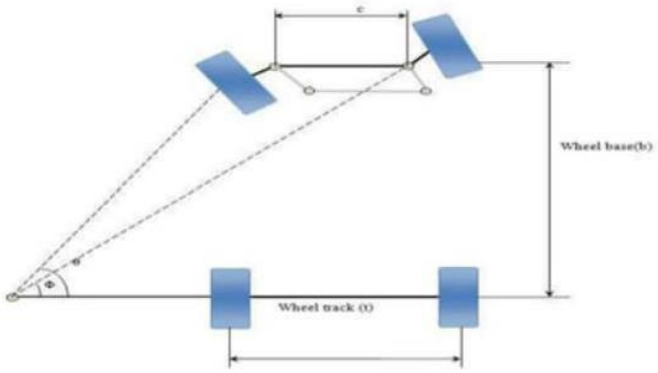
New generation of active steering systems distinguishes a need of steering of rear wheels for the reason of directional stability from a need of steering of rear wheels for the reason of cornering at slow speed.

At High Speeds, turning the rear wheels through an angle opposite to front wheels might lead to vehicle instability and is thus unsuitable. Hence the rear wheels are turned in the same direction of front wheels in four-wheel steering systems

The 4WS system performs two distinct operations: in- phase steering, whereby the rear wheels are turned in the same direction as the front wheels, and counter phase steering, whereby the rear wheels are turned in the opposite direction. The 4WS system is effective in the following situations:

Zero steer can significantly ease the parking process, due to its extremely short turning footprint. This is exemplified by the parallel parking scenario, which is common in foreign countries and is pretty relevant to our cities. Here, a car has to park it between two other cars parked on the service lane. This maneuver requires a three-way movement of the vehicle and consequently heavy steering inputs. Moreover, to successfully park the vehicle without incurring any damage, at least 1.75 times the length of the car must be available for parking for a two-wheel steered car.

Another driving maneuver that frequently becomes cumbersome and even dangerous is changing lanes at fairly high speeds. Although this is less steering intensive, this does not require a lot concentration from the driver since he has to judge the space and vehicles behind him. Here is how crab mode can simplify this action.



While tackling a turn, the condition of perfect rolling motion will be satisfied if all the four wheel axes when projected at one point called the instantaneous centre, and when the following equation is satisfied:

3. EXPERIMENTAL DETAILS

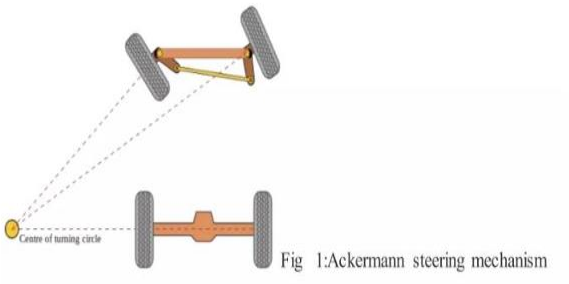
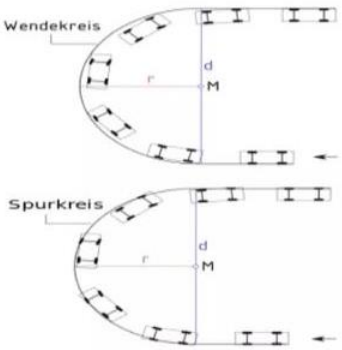


Fig 1:Ackermann steering mechanism



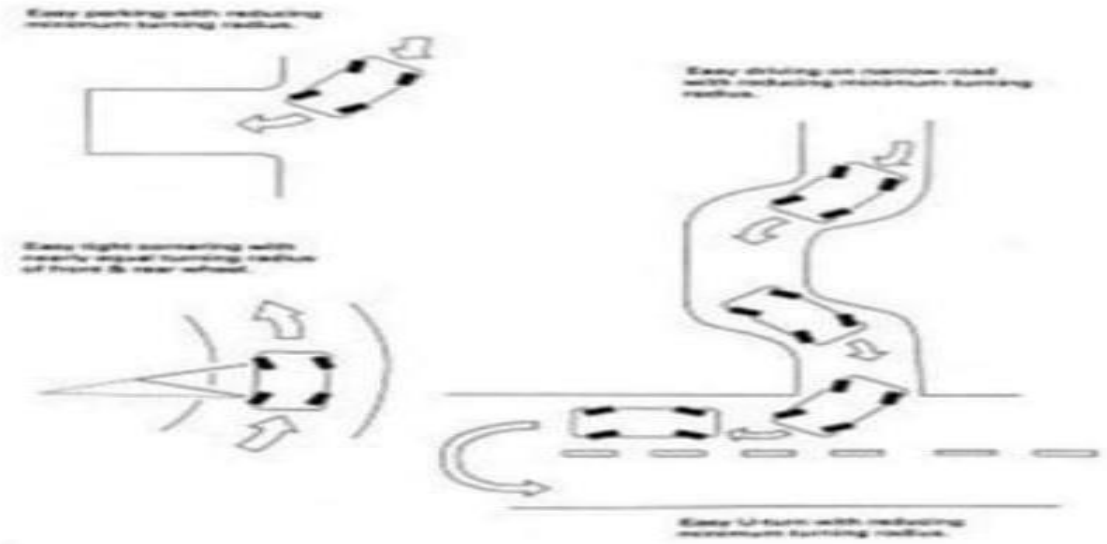


Fig. 5 – Car in Various Modes

3.2 Mechanical 4WS SYSTEM

In a straight-mechanical type of 4WS, two steering gears are used-one for the front and the other for the rear wheels. A steel shaft connects the two steering gearboxes and terminates at an eccentric shaft that is fitted with an offset pin**.**

3.3 HYDRAULIC 4WS SYSTEM:

In the hydraulic four-wheel-steering system, the rear wheel turns only in the same direction as the front wheels. This system limits rear wheel movement to 5.5 degrees in either the left or right direction. A two-way hydraulic cylinder mounted on the rear stub frame turn the wheels. Fluid for this cylinder is supplied by a rear steering pump that is driven by the differential. The pump only operates when the front wheels are turning. When the steering wheel is turned, the front steering pump sends fluid under pressure to the rotary valve in the front rack and pinion unit. This forces fluid into the front power cylinder, and the front wheels turn in the direction steered. The fluid pressure varies with the turning of the steering wheel..

3.4 Electro- hydraulic 4WS system

The Ackerman Steering Principle defines the geometry that is applied to all vehicles (two or four wheel drive) to enable the correct turning angle of the steering wheels to be generated when negotiating a corner or a curve.

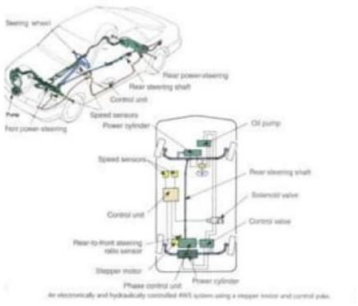
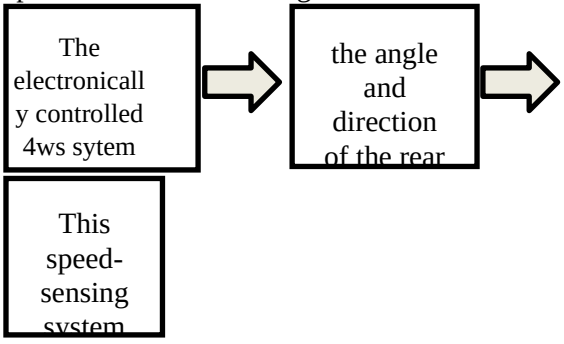


Fig. 8 Electro Hydraulic 4WS

Fig.3 ACKERMANSTEERINGMECHANISM

3.5 PROPOSEDMETHODOLOGY

Stepper motor action eventually causes a push-or-pull movement of its output shaft to steer the rear wheels up to a maximum of 5 degrees in either direction.



4. FABRICATIONANDASSEMBLY

4.1 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.

4.2 Ball 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.The Brake wheel is made of Polyvinyl Chloride (PVC).

4.3 Tire:

A tire (British tyre) is a ring of material that covers the rim of a wheel. Most road vehicles and many other vehicles use rubber tires. Tires help vehicles to move smoothly..

4.4 Wheel Hub or Spindle

They come in different sizes and have different tread patterns. There are many different sizes of tires. On car and truck tires, they are marked with 3 numbers and might look like: 225/60R 16..

4.5 Nuts and bolts

Anut is a type of fastener with a threaded hole. Nuts are almost always used in conjunction with a mating bolt to fasten multiple parts together..

4.6 Drive shaft

whilst avoiding too much additional weight as that would in turn increase their inertia.

4.7 Steering

Steering is the collection of components, linkages, etc..

5. OBSERVATION

A model of regenerative braking system is fabricated .After successful testing, the system is able to stop the vehicle by producing energy in return.

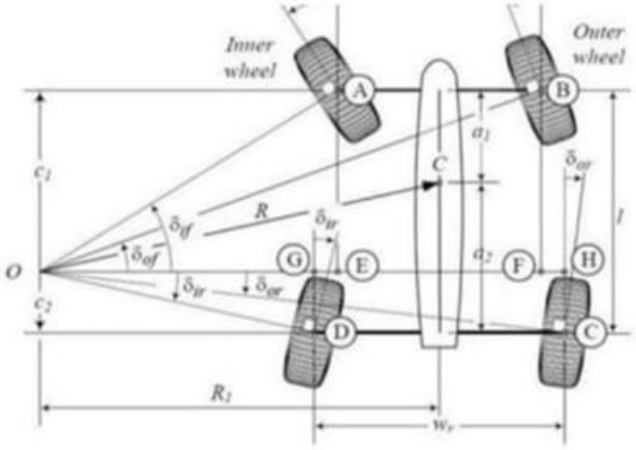


Fig 4 Fig. 25– Steering angles position of instaneous Centre for turning radius 4.4m

Fig. 20– Welding Operations

TABLE 1
OBSERVATION DATA

MS medium with NAA mg L⁻¹	MS medium with BAP mg L⁻¹	Percent regenerated plantlet	Number of plantlets callus⁻¹	Average plantlet height (cm)	Average root length (mm)	Number of root plantlet⁻¹
0.1	0.5	16.67 l	3.17 i	3.00 ef	2.83 cdef	2.92 fgh
0.1	1.0	20.00 kl	4.50 ghi	2.83 efg	2.67 def	3.71 cdef
0.1	2.0	26.67 ijk	7.02 cde	3.67 cde	3.83 bc	4.06 cde
0.1	4.0	23.33 jkl	4.50 ghi	2.83 efg	3.83 bc	3.63 cdef
0.25	0.5	26.67 ijk	4.17 hi	3.33 def	3.83 bc	3.26 efg
0.25	1.0	30.00 hij	6.83 def	5.50 b	3.33 cde	3.99 cde
0.25	2.0	33.33 ghi	7.83 bcd	4.00 cd	3.50 bcd	3.97 cde
0.25	4.0	23.33 jkl	6.83 def	3.40 def	3.50 bcd	4.87 b
0.5	0.5	33.33 ghi	3.50 i	3.50 def	2.83 cdef	3.41 defg
0.5	1.0	40.00 fg	8.17 bcd	4.17 cd	3.17 cdef	4.34 bc
0.5	2.0	36.67 gh	8.50 bc	4.33 c	2.67 def	2.95 fgh
0.5	4.0	30.00 hij	4.67 ghi	2.17 g	2.33 ef	3.00 fgh
1.0	0.5	46.67 ef	8.83 b	5.50 b	2.83 cdef	4.38 bc
1.0	1.0	56.67 bcd	8.50 bc	6.00 ab	2.50 def	4.05 cde
1.0	2.0	60.00 bc	8.50 bc	5.50 b	2.50 def	4.18 bcd
1.0	4.0	50.00 de	5.50 fgh	3.50 def	2.17 f	2.79 gh
2.0	0.5	56.67 bcd	5.83 efg	2.77 fg	2.16 f	2.25 h
2.0	1.0	70.00 a	12.33 a	10.18 a	7.33 a	5.90 a
2.0	2.0	63.33 ab	9.17 b	3.33 def	4.50 b	4.00 cde
2.0	4.0	53.33 cde	7.17 cde	3.50 cdef	2.17 f	3.45 defg

6. APPLICATIONS

6.1 Parking:

during a parking a vehicles driver typically tums 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 radius then is possible with 2ws. As a result vehicle is turned in small radius at parking.

6.2 Junctions:

on a cross roads or other junction where roads intersect at 90 degree 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 function.

7. CONCLUSION

This paper focused on a steering mechanism which offers feasible solutions to a number of current maneuvering limitations. Different mechanisms were adopted by trial and error method in order to facilitate the engagement of the wheels in the required direction, and the most convenient method was adopted. Thus the four wheel steering system is a relatively new technology that imposes comering capability, steering response, straight-line stability, lane changing and low-speed maneuverability in cars, trucks and trailers. The aim of 4WS system is a better stability during overtaking manoeuvres, reduction of vehicle oscillation around its vertical axis, reduced sensibility to lateral wind,

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