# A REVIEW PERFORMANCE OF STEERING SYSTEM MECHANISM

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***Abstract: The controlling behavior of a vehicle is influenced by the performance of its steering system. The steering system consists of steering wheel, steering column, rack and pinion, steering gearbox, and a linkage system. The vehicle is controlled by the behavior of the steering gear with the spring loaded rack and pinion. In standard 2 Wheel Steering System, the rear set of wheels are always directed forward and do not play an active role in controlling the steering. While in 4 Wheel Steering System, the rear wheels do play an active role for steering, which can be guided at high as well as low speeds. Production cars are designed to under steer and rarely do they over steer. Production cars are designed to under steer and rarely do they over steer. If a car could automatically compensate for an under steer/over steer 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.***

## I. INTRODUCTION

The aim of the paper is a car could automatically compensate for an under steer/over steer problem, the driver would enjoy nearly neutral steering under varying operating conditions. 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 a sedan's larger wheel base and track width.[1] Hence there is a requirement of a mechanism which result in less turning radius. The rack-and-pinion steering system converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels, and provides a gear reduction, making it easier to turn the wheels. On most cars, it takes three to four complete revolutions of the steering wheel to make the wheels turn from lock to lock (from far left to far right). Turning of wheels depends on the steering ratio. It is the ratio between the angle turned by the steering wheel and the angle turned by the road wheel. A higher ratio means that one has to turn the steering wheel more to get the wheels to turn a given distance, and vice versa. A rack and pinion assembly must satisfy specific requirements, such as backlash elimination, etc. [2]4 Wheel Steering System is employed in vehicles to achieve better maneuverability at high speeds, reducing the turning circle radius of the car and to reduce the driver's steering effort. In most active 4 wheel steering system, the guiding computer or electronic equipment play a major role, in our project we have tried to keep the mechanism as much mechanical as possible which can be easy to manufacturing and maintenance. In city driving conditions the vehicle with higher wheelbase and track width face problems of turning as the space is confined, the same problem is faced in low speed cornering. Usually customers pick the vehicle with higher wheelbase and track width for their comfort and face these problems, so to overcome this problem a concept of four wheel steering can be adopted in the vehicle. Four wheel steering reduces the turning radius of the vehicle which is effective in confined space, in this project four wheel steering is adopted for the existing vehicle and turning radius is reduced without changing the dimension of the vehicle.[3]

## II. OPERATING MECHANISMS

There are two basic steering mechanisms:
- Rack and pinion steering
- Reticulating ball steering.

Most modern cars use the rack and pinion steering mechanism. The recirculating ball mechanism has the advantage of a much greater torque multiplication, thus it was originally used on larger, heavier vehicles while the rack and pinion was limited to smaller and lighter cars. But with the almost universal adoption of power steering, this is no longer an important advantage, leading to the increasing use of the rack and pinion mechanism on new cars. However, power-assisted recirculating ball steering systems are still applied today in dynamic sports cars, upper class cars, off-road vehicles and vans. Despite the ability to safely transmit high torques, the recirculating ball system is characterized by low system friction, high efficiency and good noise performance. In the rack and pinion system, a pinion gear is attached to the steering shaft, i.e. turning the steering wheel turns the pinion gear which then moves the rack. The rack and pinion gear is enclosed in a metal tube, with each end of the rack protruding from the tube. It does two things: ñ It converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels. ñ It provides a gear reduction, making it easier to turn the wheels.[2] A tie rod at each end of the rack connects via the swivel ball joint to the steering arm which finally moves the wheel. The specific

advantage of the rack and pinion design is a good feedback and a direct steering "feel". In a recirculating ball steering box, a box is clamped over a worm drive that contains dozens of ball bearings. The ball bearings loop around the worm drive and then out into a recirculating channel where they are fed back into the worm drive again. As the steering wheel is turned, the worm drives turns and forces the ball bearings to press against the channel inside the nut. This forces the nut to move along the worm drive. The nut itself has a couple of gear teeth cast into the outside of it and these mesh with the teeth on a sector gear which is attached to the cross shaft.[4]

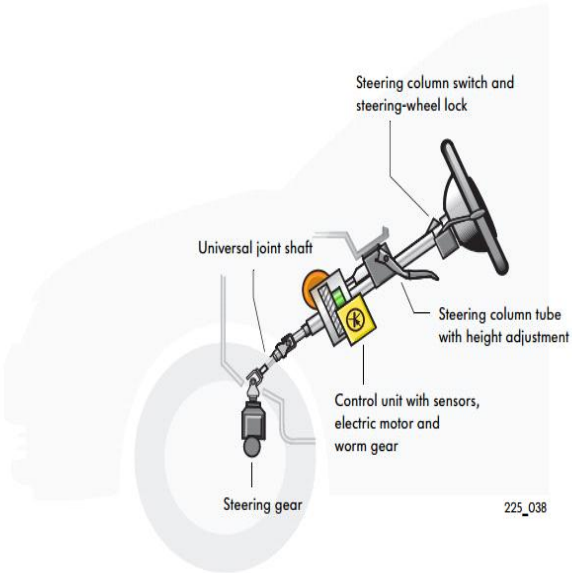



Figure: 1. Operating mechanisms of power steering system

## III. COMPONENT PARTS OF THE STEERING COLUMN

The main components of the new power steering System are:
- The steering column switch,
- The steering column tube,
-The worm gear, steering position sender, and steering moment sender
- The electro-mechanical power steering motor,
- The steering column electronics control unit, and
- The universal joint shaft to the mechanical steering gear.[5]

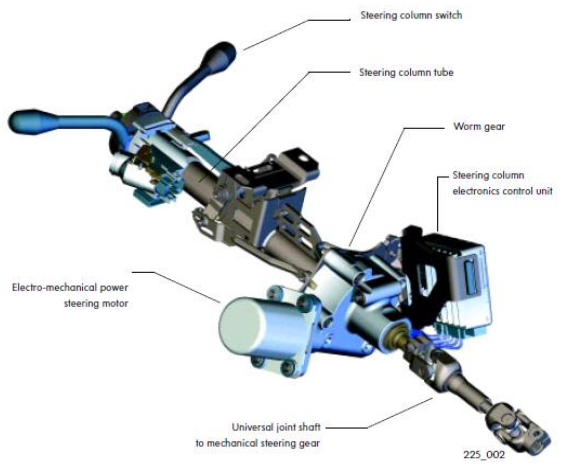



Figure:2. The component parts of the steering column

## IV. INFLUENCE OF STEERING PROPERTY ON VEHICLE HANDLING CHARACTERISTICS

The main task of the power steering system is to reduce, not remove, the steering effort of the driver by adding a certain amount of torque to the driver's torque, while at the same time supplying the driver with a relevant amount of road feel through the steering wheel torque. Assistance torque and road feel are an inherent compromise in conventional hydraulic steering systems due to the system's architecture, which will be discussed later. Car companies have spent a great deal of effort in balancing these two characteristics.[6]

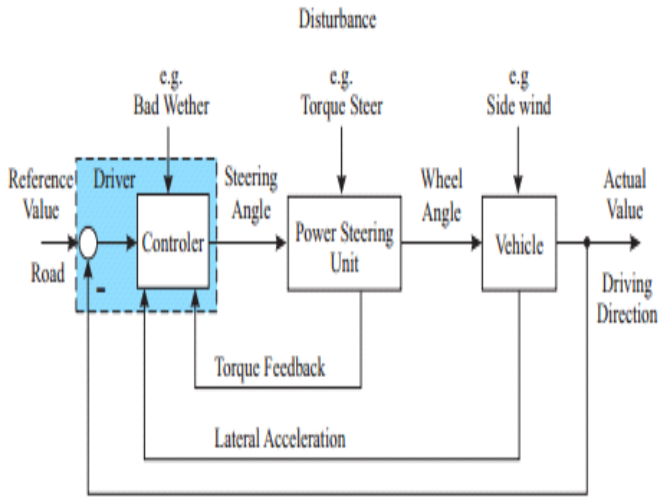



Figure: 3. The power steering system is part of the vehicle's closed loop

Driving a car is really a closed loop system, where the driver is the controller and the steering unit is the actuator. The steering system transfers the steering wheel angle to the wheel angle, where the action changes the heading of the vehicle. As the main reference, the driver uses the visual information to place the car on the road, he/she also uses the lateral acceleration and the torque fed back via the steering wheel to ensure that the steering command is performed in the intended way. This closed loop system is described in Figure where mit can be seen that different instances are subjected to disturbances, which will affect the driving performance. This figure will be used to discuss the possibility to reduce the effect of the disturbance. In the loop, it is noticeable that the power steering unit is closest to the controller, which means that the first feedback concerning the commanded steering wheel angle is from the steering wheel.[3]

## V. AIMS OF DEVELOPMENT

Application areas for rolling bearings The aims of further developments and optimization in the field of passenger car chassis are primarily:

- low vibration levels.
- more straightforward handling of components relevant to operation .
- improved steering comfort the improvement of

active safety to minimize the effects of emergency situations.

- The improvement of the passive safety by means of measures to reduce the results of accidents.
- Safety steering columns, collapsible and energy absorbing steering wheels.

Considerable advancements have been achieved by fine adjustment of the axle kinematics and suspension, E.g. multi-link suspension and axle integrated systems. The future belongs to "intelligent chassis" which obviously will automatically adjust themselves to the relevant driving conditions. Adjustment of the chassis is not limited to just the individual suspension and damping components but includes the associated areas of:Drive and braking, driving comfort and driving safety and steering stability and road holding.[2]
Current chassis regulation systems such as ABS (anti-lock systems) and ASR or ETC (traction control) improve driving comfort and safety considerably. Further developments will make increased use of electronic components, and hydraulic elements will gradually be superseded. The increasing functionality of the complete component gives rise to increased importance of the rolling bearings. The most significant Application areas for rolling bearings in the chassis are:
The steering column,
The steering gear,
The suspension and the McPherson strut bearings and
The braking system– without or with ABS.[1-3]

## VI. FUNCTIONAL DESCRIPTION

*A. Function of Steering System*

• Control of front wheel (sometimes rear wheel) direction.
• Maintain correct amount of effort needed to turn the wheels.
• Transmit road feel (slight steering wheel pull caused by the road surface) to the drivers hand.
• Absorb most of the shock going to the steering wheel as the tire hits holes and bumps in the road.
• Allow for suspension action.

*B. The steering operation*

The diagram shows a steering column which is split into an upper section and a lower section. The steering moment sender is integrated in the upper section, while the steering position sender is located in the lower section. The driver starts to turn the steering wheel. The torsion bar is rotated at the same time. The steering moment sender, which rotates together with the torsion bar, supplies the control unit signals indicating the magnitude and direction of rotation of the torque acting on the steering wheel. The control unit calculates the torque assistance required from the signals and activates the electric motor. The aggregate of torque acting on the steering wheel and torque assistance is the effective torque acting on the steering gear. If the driver increases the torque applied to the steering wheel, the electric motor increases torque assistance. This allows the steering gear to rotate easily. If the driver reduces the torque applied to the steering wheel, the torsion of the torsion bar is reduced. As a result, the steering moment sender supplies a lower signal to the control unit. The control unit reduces the torque assistance by activating the electric motor. Due to the wheel alignment, the steering system tries to restore the wheels to the straight-ahead position. If resultant restoring moment via the steering gear is greater than the aggregate of the torque acting on the steering wheel and the torque assistance, the system begins to turn the steering back to the straight-ahead position.[3-5]

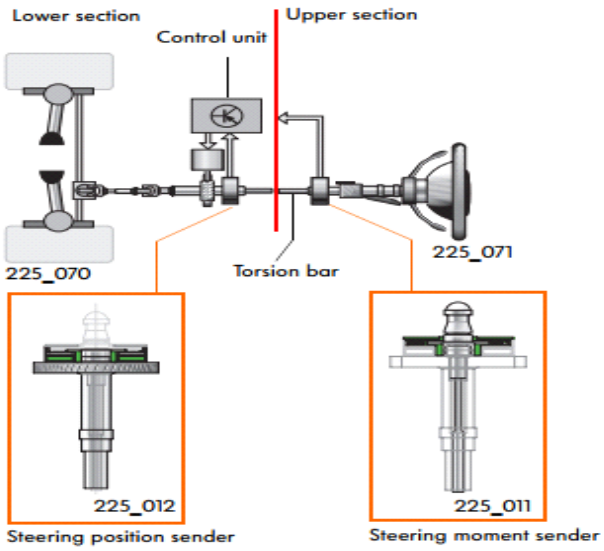
## VII. TYPES OF STEERING POWER SYSTEM

*A. The hydraulic power steering system*

In the hydraulic power steering system, the system components after the universal joint shaft are engaged in the steering operation, whereby steering is assisted by oil pressure. Power steering is one type of hydraulic device for utilizing engine power to reduce steering effort. Consequently, the engine is used to drive a pump to develop fluid pressure, and this pressure acts on a piston within the gear box so that the piston assists the sector shaft effort. The amount of this assistance depends on the extent of pressure acting on the piston. Therefore, if more steering force is required, the pressure must be raised. The variation in the fluid pressure is accomplished by a control valve which is linked to the intermediate shaft and the steering main shaft.

*B. The electro-mechanical power steering system*

In the electro-mechanical power steering system, steering is assisted in front of the universal joint shaft. In this system, the assisting moment is generated by an electric motor. The electro-mechanical power steering system assists the steering movement performed by the driver by means of an electric motor. This motor, in turn, drives a worm gear. The speed-dependent steering system conveys a direct steering feel, without any annoying feedback from the road to the driver. This Self-Study Programmer explains this new technology and the differences compared with conventional hydraulic power steering systems. The electro-mechanical power steering system is currently fitted to the up to 3L TDI.[1-4]



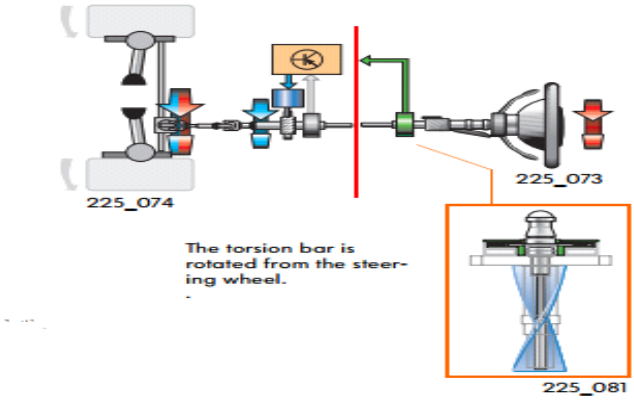



Figure: 4. Electro-mechanical power steering system

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