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Electronic Power Assisted Steering System

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ABSTRACT

Electric power steering (EPS or EPAS) is designed to use an electric motor to minimize the effort by providing steering assist to the driver of a vehicle. Sensors detect he motion and torque of the steering column, and a computer module apples assistive torque via an electric motor coupled directly to either the steering gear or steering column. This allows varying amounts of assistance to be applied depending on driving conditions. The system provides engineers to shoehorn steering-gear response to variable-damping suspension systems achieving a perfect blend of ride, handling, and steering for each and every vehicle. This effect of global warming is becoming increasing apparent. As a result, we product engineers are being asked to develop products that are more friendly to the earth's environment electric power (EPS) is such a product. By using power only when the steering wheel is turned by the driver, it consumes approximately one-twentieth the energy of conventional hydraulic power steering system and, as it does not contain any oil, it does not pollute the environment both when it is produced and discarded.

Keywords: EPS, pinion, pump, rack, sensors

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INTRODUCTION

Electrically powered steering uses an electric motor to drive either the power steering hydraulic pump or the steering linkage directly. The power steering function is not depended on speed of engine, resulting in significant energy savings.

Conventional power steering systems use an engine accessory belt to drive the pump, providing pressurized fluid that operates a piston in the power steering gear or actuator to assist the driver.

In electro-hydraulic steering, one electrically powered steering concept uses a high efficiency pump driven by an electric motor. Pump speed is organized by an electric controller to deviate pump pressure and flow, providing steering activity tailored for different driving situations. The pump can be run at low speed or shut off to provide energy savings during straight ahead driving (which is most of the time in most world markets). Direct electric steering uses an electric motor bind with the steering rack through a gear mechanism called as no pump or fluid [1–3]. A variety of motor types and gear drives is possible. A microprocessor controls steering dynamics and driver effort. Inputs include vehicle speed and steering, wheel torque, angular position and turning rate (Figure 1).

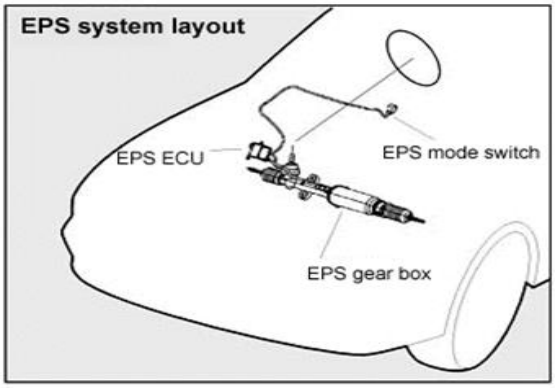

Fig. 1. *EPS layout.*

DESCRIPTION

Electronic power steering (EPS) is an advanced power steering system. With the help of this system there is no need for a power Steering pump, hoses, hydraulic fluids, and a drive belt and pulley on the engine. As a result, electric power steering is more energy efficient and environmentally compatible while offering extras like simplified tuning and packaging flexibility.

Electronic Power Steering System in a regular steering application, which incorporates a steering gear, assist mechanism, brushless motor and electronic controller to provide responsive steering assist. Sensors measure two primary inputs driver torque (or effort) on the steering and hand wheel position. There are two primary inputs along with the vehicle speed signal and other system variables are nonstop fed into an electronic control module, which performs two main functions. First, it ascertains the integrity of the signals and inputs. And second, it determines the direction and amount of steering assist. While development of complex control algorithms for action purposes is very important, it is critical for the system to diagnose the validity of all signals and inputs, and take corrective actions, if necessary [4, 5].

There are many integrity features built into EPS. This system continuously runs detailed self-checks and diagnostics, ensuring that all areas of the system are functioning as designed. And there is any Warning light is also lighten to alert the driver (Figure 2).

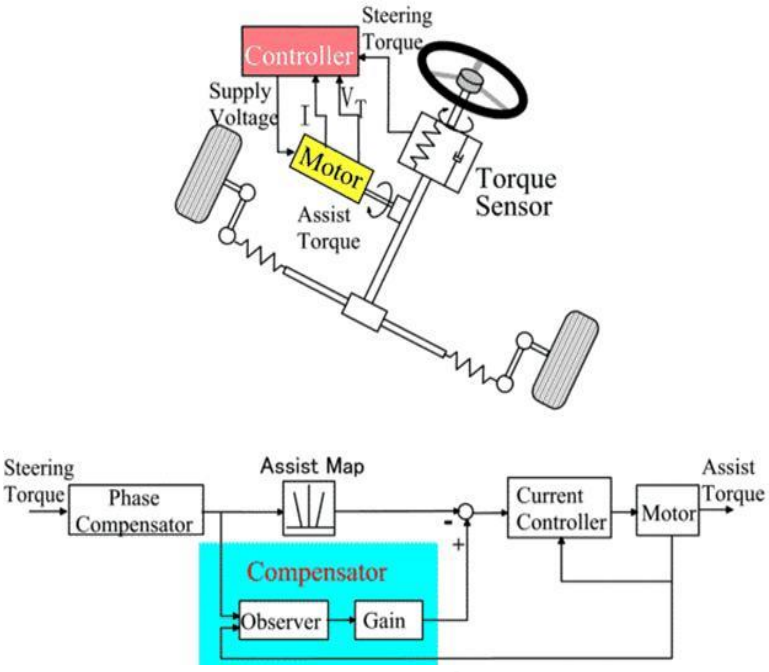

Fig. 2. *EPS mechanism.*

Steering sensor's input are designed by a microchip control unit that also monitors input from the vehicle's speed sensor. The sensor inputs are then compared to determine how much power assist is required according to a preprogramed "force map" in the control unit's memory. The control unit then sends out the right command to the "power unit" which then supplies the electric motor with current. The motor pushes the rack to the right or left depending on which way the voltage flows (reversing the current reverses the direction the motor spins). Increasing the current to the motor increases the amount of power assist (Figure 3) [6, 7].

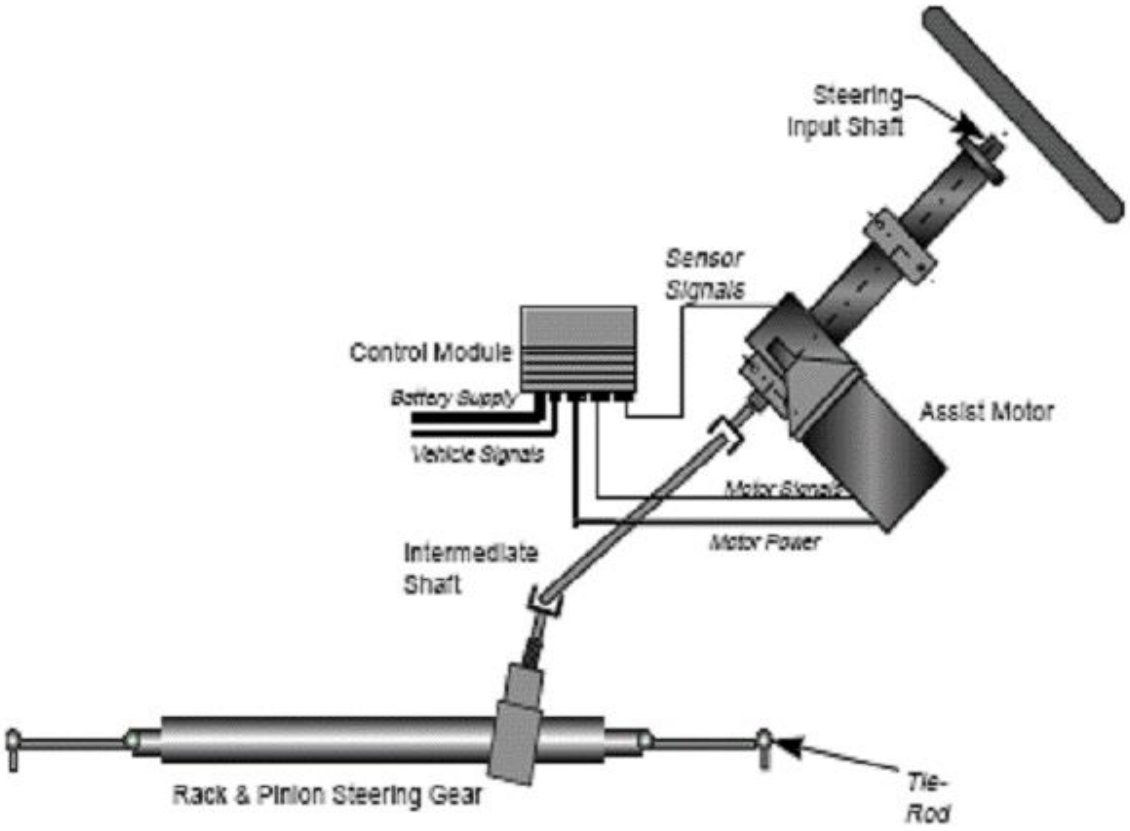

Fig. 3. *Power steering system.*

WORKING DETAILS

A “steering sensor” is located on the input shaft where it enters the gearbox housing. The steering sensor is actually two sensors in one: a "torque sensor" that converts steering torque input and its direction into voltage signals, and a "rotation sensor" that converts the rotation speed and direction into voltage signals. An "interface" circuit that shares the same housing change over the signals from the torque sensor and rotation sensor into signals the control electronics can process.

The system has three operating modes: a "normal" control mode in which left or right power assist is provided in response to input from the steering torque and rotation sensor's inputs; a "return" control mode which is used to help steering return after completing a turn and a "damper" control mode that changes with vehicle speed to better road feel and dampen kickback.

If the steering wheel is turned and held in the full-lock position and steering assist reaches a maximum, the control unit reduces current to the electric motor to prevent an overload situation that might damage the motor. The control unit is also designed to save the motor against voltage flow from a faulty alternator or charging problem (Figures 4, 5).

FUNCTIONS

(a) Helps in swing the wheels to left or right.
(b) Helps in turning the vehicle at the will of driver with less effort.
(c) It provides directional stability.
(d) It helps the controlling wear and tear of tyres.
(e) It helps in achieving the self-retuning effect.
(f) It converts the rotary movement of steering wheel into an angular turn of the front wheels.

(a) It multiplies the effort of the driver by leverage in order to make it fairly easy to turn the wheels.
(b) It absorbs a major part of the road shocks there by preventing them to get transmitted to hands of the driver.

Classification of EPS

EPS can mainly classify in to 3 kinds depending up on the position.

- Column assist type
- Pinion assist type
- Rack assists type.

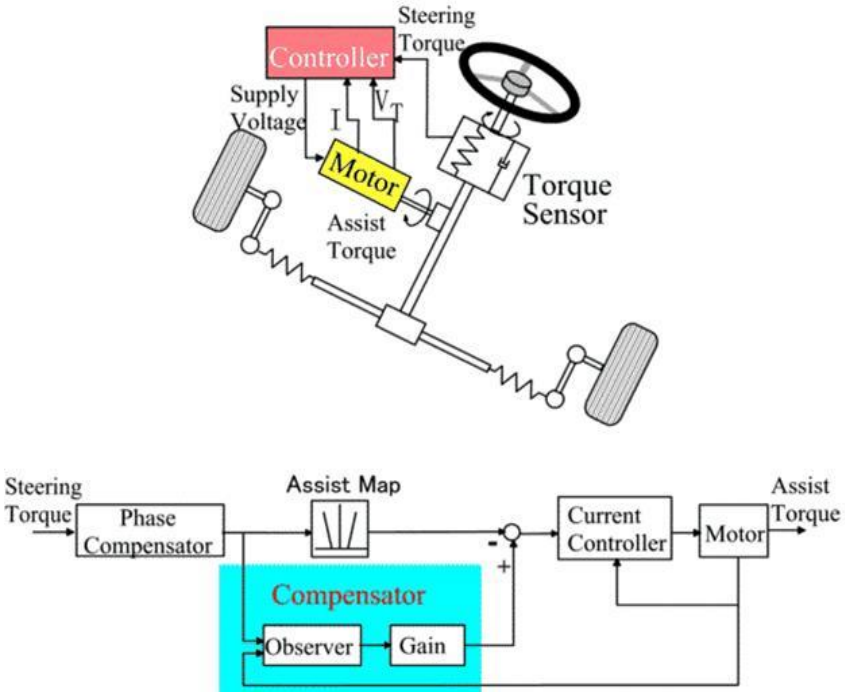

Fig. 4. *Working mechanism.*

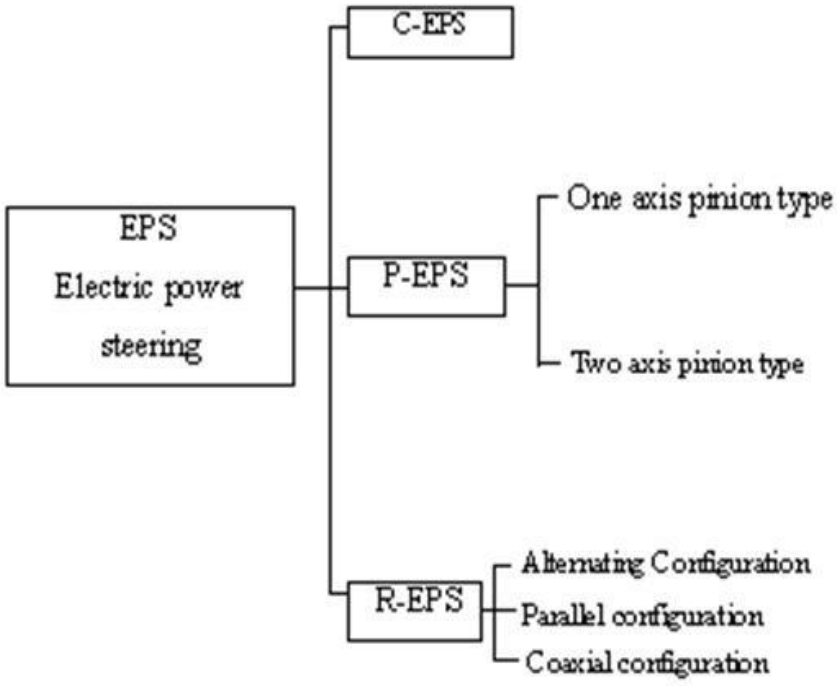

Fig. 5. *Classification flow chart.*

(A) Column-assist type:

- The power assist unit, controller and the torque sensor are attached to the steering column.
- This system is close-packed and easy to mount on vehicle.
- The power assist system can be used to fixed steering columns, tilt-type steering columns and other column types.
- An integrated pivot/mount and integrated controller option increase mounting flexibility.
- Shafts offer long-term durability performance at much higher torsion loading (Figure 6).

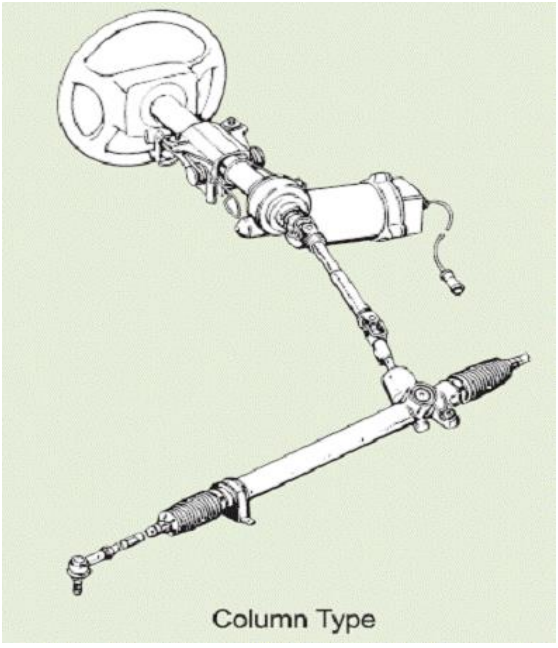

Fig. 6. *Column type EPS.*

(B) Pinion-assist type:

- The power assist unit is connected to steering gears pinion shaft.
- The power assist unit is outside the vehicles passenger compartment, allowing assist torque to be increased greatly without raising interior noise. Combined with a variable ratio steering gear, this system can fulfil with a compact motor and offer superior handling characteristic (Figure 7).

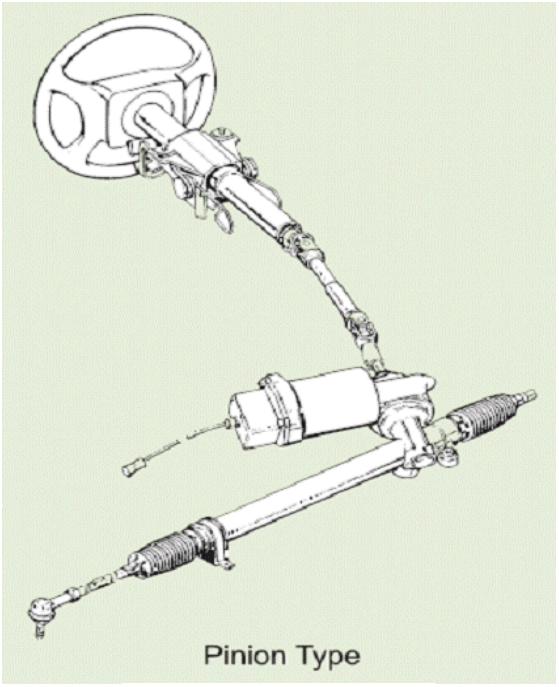

Fig. 7. *Pinion type EPS.*

(C) Rack-assist type:

- The power assist unit is connected to the steering gear rack.
- The power assist unit can be located freely on the rack, allowing great flexibility in layout design.
- The power assists units? High reduction gear ratio enables very low inertia and superior driving feel.
- Enlarge packaging flexibility with a symmetrical motor that can be positioned anywhere around the rack.
- Electric power steering rack assist is a scalable system, suitable for midsize cars to full-size trucks.

CONTROL BLOCK DIAGRAM FOR EPS SYSTEM

The electronic steering control unit is resourceful control unit of self-diagnosing faults by monitoring the system's inputs and outputs, and the driving current of the electric motor. If a problem occurs, the control unit turns the system off by actuating a fail-safe relay in the power unit. This removes all power assist, causing the system to turn back to manual steering. A dash EPS warning light is also

lightened to alert the driver. To diagnose the problem, a technician jumps the terminals on the service check connector and reads out the trouble codes (Figure 8).

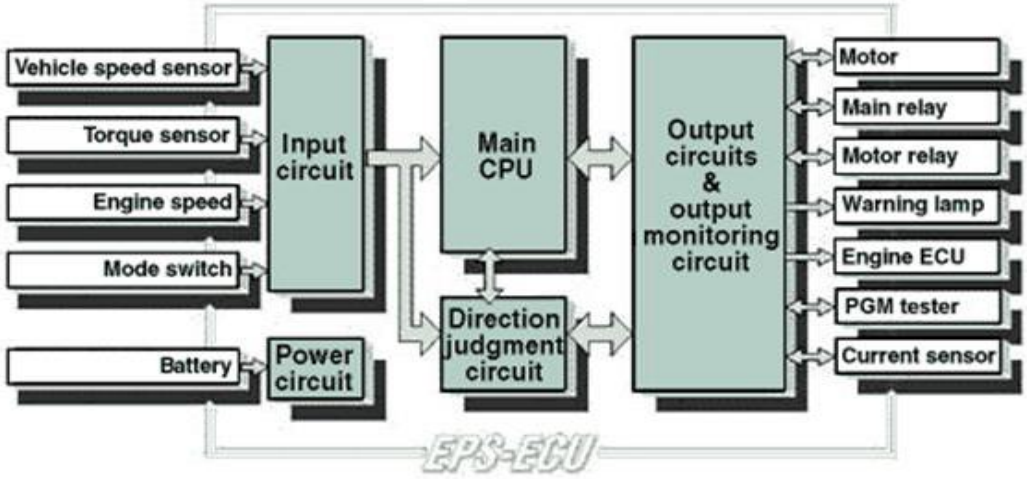

Fig. 8. *Block diagram.*

KEY BENEFITS

(1) EPS provides a more flexible and low priced steering system than a formal and conventional hydraulic system.
(2) Aid automotive environments (–40 to +125°C).
(3) Provide a low-priced device and system solution with wider market application availability.
(4) Active return-to-canter for enhanced return ability, requiring less driver effort.
(5) Active damping, designed to eliminate overshoot during "back-to-canter" return for improved vehicle stability and safety.
(6) Active torque damping for reduction in steering pull during acceleration.
(7) Engine independence reduces parasitic losses, helps increase fuel economy, and improves acceleration times.
(8) Enhances dependability and safety, with power steering available even when the engine is off.
(9) Compact, modular design and flexible tuning capability reduces variations required for various models in a given platform.
(10) Helps reduce assembly plant time by up to four minutes.
(11) Multiple configurations for use on a full range of vehicles.

CONCLUSION

EPS has got upper hand compared to hydraulic power steering because [8].

- Reduced driver fatigue.
- Enhances dependability and safety.
- Compact, modular design and flexible tuning capability.
- Helps improve fuel economy by reducing the pressure the pump has to work against during straight-ahead highway speed driving.
- Accommodates most vehicle platforms.
- Reduced steering system operating temperature.
- Lower noise under all driving conditions.

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