Automatic Head Lamp Steering System

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Abstract: Front head lamps of automobiles provide a wide beam of light generally aimed and mounted low. They are intended for use at low speed to increase illumination of the road surface particularly in conditions of poor visibility due to rain, fog or snow. Normally the head lamps are focused only towards the front in a straight line. Present investigation is to design an automatic control mechanism which will be able to move the lamps in and towards the direction of turn, which would illuminate the road which is intended for viewing by the driver. The design and fabrication of the automatic head lamp steering system with the help of rack and pinion arrangement which will turn the head lamps in appropriate direction. This system would enhance the visibility and thereby reduce the accidents due to poor visibility in the existing vehicles and this system can be used as standard fitting in new vehicles.

Keywords—illumination, steering, head lamp, rack and pinion, visibility

I. INTRODUCTION

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, via the steering column, which may contain universal joints to allow it to deviate somewhat from a straight line. Many modern cars use rack and pinion steering mechanisms, where the steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, converting circular motion into linear motion along the transverse axis of the car. Many a times while driving the vehicle in the night the driver feels a need to look into the direction that he wishes to turn before the actual vehicle turns. This is especially very much necessitated in Ghats, Mountainous terrain where the visibility is poor while cornering. Many a times because of poor visibility and not knowing where the vehicle is going, the driver makes mistakes leading to catastrophic outcomes.

II. LITERATURE REVIEW

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.

Condition for True Rolling

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 center, and when the following equation is satisfied [1]:

III. METHODOLOGY

Power steering assists the driver of an automobile in steering by directing a portion of the vehicle's power to traverse the axis of one or more of the road wheels. As vehicles have become heavier and switched to front wheel drive, particularly using negative offset geometry, along with increases in tire width and diameter, the effort needed to turn the steering wheel manually has increased — often to the point where major physical exertion is required. To alleviate this, auto makers have developed power steering systems: or more correctly power-assisted steering — on road going vehicles there has to be a mechanical linkage as a failsafe. There are two types of power steering systems—hydraulic and electric/electronic. A hydraulic-electric hybrid system is also possible. A hydraulic power steering (HPS) uses hydraulic pressure supplied by an engine-driven pump to assist the motion of turning the steering wheel. Electric power steering (EPS) is more efficient than the hydraulic power steering, since the electric power steering motor only needs to provide assistance when the steering wheel is turned, whereas the hydraulic pump must run constantly. In EPS, the assist level is easily tunable to the vehicle type, road speed, and even driver preference. An added benefit is the elimination of environmental hazard posed by leakage and disposal of hydraulic power steering fluid. Also in the event of the engine cutting out, assist will not be lost – where as hydraulic will stop working, as well as making the steering doubly heavy as the driver has to turn the power-assist mechanism on top of the steering system itself.
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.

III MINIMUM NUMBER OF TEETH TO AVOID INTERFERENCE

For Pinion, the number of teeth on the pinion (TP) in order to avoid interference may be obtained from the following relation:

$$T_P = \frac{2A_w}{G\sqrt{1 + \frac{1}{G}(\frac{5}{6} + 2)\sin^2 \theta - 1}}$$

Where, $A_w =$ Fraction by which the standard addendum for the wheel should be multiplied

$G =$ Gear ratio or velocity ratio = $T_R / T_P$ $T_R =$ Number of teeth on rack = 126

$T_PF =$ Number of teeth on pinion = 20

Pressure angle = 20°

Thus, substituting these values in the above equation,

$$T_PF = \frac{2 \times 1}{1.3\sqrt{1 + \frac{1}{1.5}(\frac{1}{1.5}+2)\sin^2 20° - 1}}$$

Therefore, Assuming number of teeth on pinion to avoid interference is 20[2].

Maruti 800 car specifications

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Dimensions</th>
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</thead>
<tbody>
<tr>
<td>Turning circle radius (R)</td>
<td>5.394m</td>
</tr>
<tr>
<td>Weight of car (W)</td>
<td>1500kg</td>
</tr>
<tr>
<td>Weight Distribution</td>
<td>60:40 (Front : Rear)</td>
</tr>
<tr>
<td>Wheelbase (L)</td>
<td>3m</td>
</tr>
<tr>
<td>Track width (tw)</td>
<td>1.6m</td>
</tr>
</tbody>
</table>

Calculation of Steering Ratio

Steering Ratio of car is calculated by the following formula,

$$R = \frac{s}{\sqrt{2 - 2\cos(\frac{2\pi}{n})}}$$

Where,

$R =$ radius of curvature (same as units of wheelbase)

= 1.92m (75.59°)

$s =$ wheelbase = 3m (105°)

$a =$ steering wheel angle = 360° (assumed for one rotation of steering wheel)

$n =$ steering ratio (Eg. for 16:1 its 16)

$$75.59 = \frac{105.1}{\sqrt{2 - 2\cos 720° / n}}$$

$$1.39 = \sqrt{2 - 2\cos 720° / n}$$

$$1.9321 = 2 - 2\cos 720° / n$$

$$0.069 = 2\cos 720° / n$$
Thus, the steering ratio of our car is 8.177:1.

Table 2: Turning of steering wheel in degrees vs Fog lamps rotation in degrees

<table>
<thead>
<tr>
<th>Turning wheel in degrees</th>
<th>Fog lamps rotation in degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>35</td>
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<td>70</td>
<td>60</td>
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<td>80</td>
<td>70</td>
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IV. CONCLUSIONS

The vehicle’s response to steering input becomes quicker and more precise throughout the vehicle’s entire speed range. Moreover, components used in this system are easy to manufacture, material used is feasible, reliable and easily available in market.

The system assembly is easy to install and light in weight and can be implemented in all types of cars efficiently.

The vehicle’s straight-line stability at high speeds is improved.

REFERENCES