Steering Controlled Headlights

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***Abstract:** One of the biggest problems that we face while taking a turn on road is that we can't see road ahead due to fixed straight orientation of headlamps in vehicle. Solution is to synchronize headlight reflecting mirror orientation with turn angle. In case of two wheeler we don't have such problem because headlight is place on steering handle itself. So in case of four (or above) wheeler we can have a steering controlled reflecting mirror of headlight and problem will be solved. We can use same mechanism that we use to turn front wheels for turning headlight's reflecting mirror. This will enhance safety in night driving by providing full time clear view of road. A front lamp steering controlled light distribution system is disclosed having a light distribution means movable to vary a light distribution pattern to right and left maximum limit positions in cornering areas of a vehicle, and a control means responsive to a turned on state of a head lamp switch for actuating the light distribution means to cause the light distribution pattern to be varied according to a steering direction signal, indicative of an incremental steering angle of a steering wheel, in the absence of a vehicle speed signal, indicative of a vehicle speed less than a given value, and operative to drive the light distribution means to cause the light distribution pattern to be fixedly directed to the maximum limit position in response to an indicator direction signal, output from a blinker condition detection means, in the presence of the vehicle speed signal.*

***Keywords:** Steering wheel, Rack & Pinion Arrangement, Spring arrangement, Headlamps.*

I. INTRODUCTION

The steering wheel controlled headlights available as standard equipment. This system is installed only in connection with the bi-xenon headlight. The adaptive headlight performs the exterior lighting functions [1]. It also enables the bi-xenon low beam and high beam headlight to move within the driving range while cornering [2].

The swivel range of the bi-xenon low beam and high beam headlight is continuously adapted while cornering. The illuminated area while cornering therefore improves the field of view for the driver [3-4].

The adaptive illumination while cornering results in:

- Safer cornering with faster recognition of obstacles
- Improved perception of surroundings
- Accident avoidance

Figure 1. Car headlight beam

The electronic module of the adaptive headlight facilitates faster response to the current Road situation. The system is controlled by the electronic module and is therefore less Susceptible than pure mechanical systems. In addition, an emergency program can be activated via the electronic module [5-6].

II. STATEMENT OF THE PROBLEM

Car safety is the avoidance of automobile accidents or the minimization of harmful effects of accidents, in particular as pertaining to human life and health. Special safety features have been built into cars for years, some for the safety of car's occupants only, and some for the safety of others. Based on Rack and pinion mechanism the vehicle head lights are connected with the steering wheel. So easily we can overcome while cornering and assure the safety during night driving.

III. LITERATURE REVIEW

Resurrecting the turning headlight concept.
By Harald Franzen

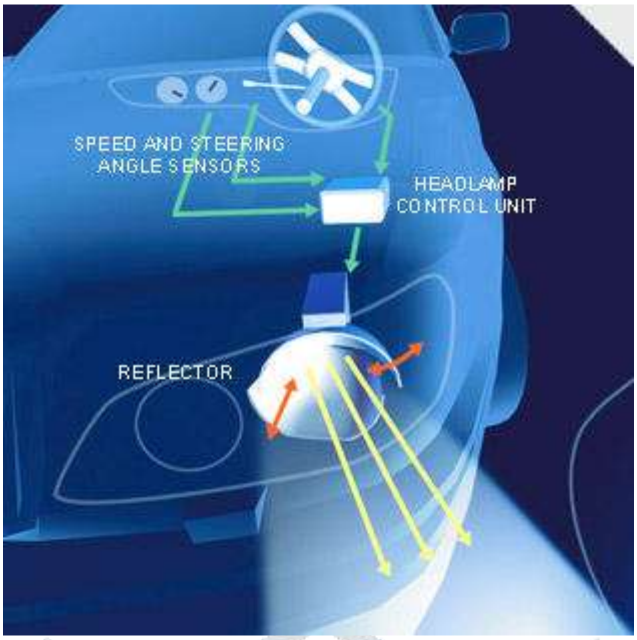

Figure 2. Headlamp control unit

Sensors send velocity and steering information to the headlamp control unit. The upper half of the headlamp reflector shifts in accordance with the vehicle's speed and direction. Illustration by Garry Marshall

When auto wizard Preston Tucker presented his legendary Car of Tomorrow in 1948, one of its most eye-catching features was a third headlight. This extra light turned with the car's front wheels, allowing the driver to see ahead when the vehicle went into a curve.

The Tucker, of course, was never mass-produced, and a combination of factors, including expense and safety concerns, led automakers to largely abandon the idea.

IV. COMPONENTS

The components which are used in Steering Controlled Head lights are as follows:

- Steering wheel
- Rack & Pinion Arrangement
- Spring arrangement

V. WORKING PRINCIPLE

5.1 Steering Wheel

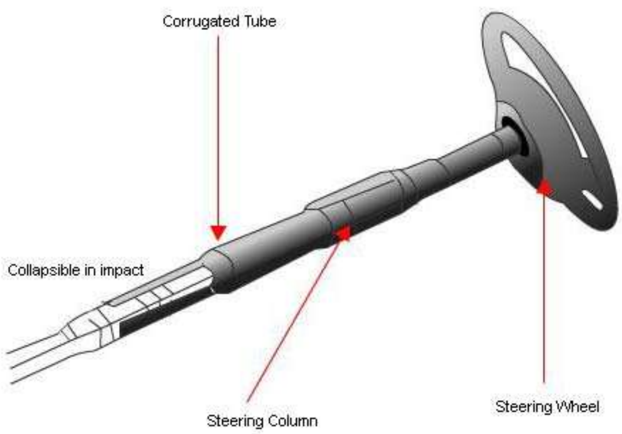

Figure 3. Steering

Steering is the term applied to the collection of components, linkages, etc. which will allow a vessel or vehicle (car, motorcycle and bicycle) to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function. 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. This motion applies steering torque to the swivel pin ball joints that replaced previously used kingpins of the stub axle of the steered wheels via tie rods and a short lever arm called the steering arm. The rack and pinion design has the advantages of a large degree of feedback and direct steering "feel". A disadvantage is that it is not adjustable, so that when it does wear and develop lash, the only cure is replacement.

Older designs often use the recirculating ball mechanism, which is still found on trucks and utility vehicles. This is a variation on the older worm and sector design. The steering column turns a large screw which meshes with a sector of a gear, causing it to rotate about its axis as the worm gear is turned; an arm attached to the axis of the sector moves the Pitman arm, which is connected to the steering linkage and thus steers the wheels. The recirculation ball version of this apparatus reduces the considerable friction by placing large ball bearings between the teeth of the worm and those of the screw; at either end of the apparatus the balls exit from between the two pieces into a channel internal to the box which connects them with the other end of the apparatus, thus they are "recirculated".

This design is still in use in trucks and other large vehicles, where rapidity of steering and direct feel are less important than robustness, maintainability, and mechanical advantage. The much smaller degree of feedback with this design can also sometimes be an advantage; drivers of vehicles with rack and pinion steering can have their thumbs broken when a front wheel hits a bump, causing the steering wheel to kick to one side suddenly. This effect is even stronger with a heavy vehicle like a truck; recirculation ball steering prevents this degree of feedback, just as it prevents desirable feedback under normal circumstances [7].

5.2 Rack & Pinion Arrangement

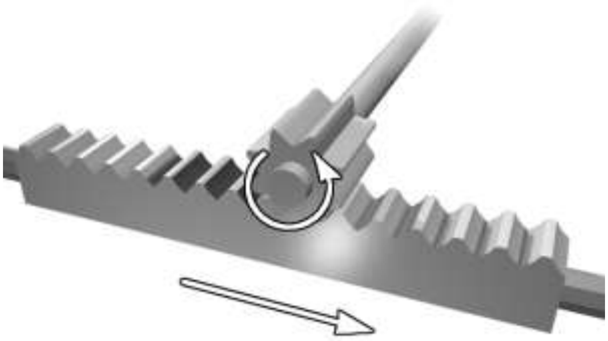

Figure 4. Rack and pinion

A **rack and pinion** is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar–the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and pulls a train along a steep slope.

The rack and pinion arrangement is commonly found in the steering mechanism of cars or other wheeled, steered vehicles. This arrangement provides a lesser mechanical advantage than other mechanisms such as recirculating ball, but much less backlash and greater feedback, or steering "feel".

For every pair of conjugate involutes profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius. A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear [8].

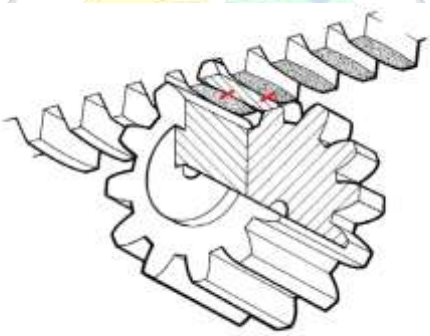

Figure 5. Gear hob

5.3 Spring Arrangement

Figure 6. Springs

A **spring** is an elastic object used to store mechanical energy. Springs are usually made out of hardened steel. Small springs can be wound from pre-hardened stock, while larger ones are made from annealed steel and hardened after fabrication. Some non-ferrous metals are also used including phosphor bronze and titanium for parts requiring corrosion resistance and beryllium copper for springs carrying electrical current.

When a spring is compressed or stretched, the force it exerts is proportional to its change in length. The rate or spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring. That is, it is the gradient of the force versus deflection curve. An extension or compression spring has units of force divided by distance, for example lbf/in or N/m. Torsion springs have units of force multiplied by distance divided by angle, such as N·m/rad or ft·lbf/degree. The inverse of spring rate is compliance, that is: if a spring has a rate of 10 N/mm, it has a compliance of 0.1 mm/N. The stiffness (or rate) of springs in parallel is additive, as is the compliance of springs in series.

Depending on the design and required operating environment, any material can be used to construct a spring, so long as the material has the required combination of rigidity and elasticity: technically, a wooden bow is a form of spring.

Hooke's law actually holds only approximately, and only when the deformation (extension or contraction) is small compared to the rod's overall length. For deformations beyond the elastic limit, atomic bonds get broken or rearranged, and a spring may snap, buckle, or permanently deform. Many materials have no clearly defined elastic limit, and Hooke's law can not be meaningfully applied to these materials. Moreover, for the super elastic materials, the linear relationship between force and displacement is appropriate only in the low-strain region [9].

VI. Description

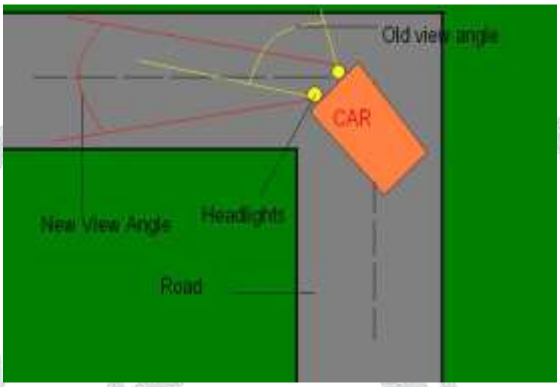

Figure 7. Headlamp angle view

A **headlamp** is a lamp, usually attached to the front of a vehicle such as a car, with the purpose of illuminating the road ahead during periods of low visibility, such as darkness or precipitation. Headlamp performance has steadily improved throughout the automobile age, spurred by the great disparity between daytime and night time traffic fatalities: the U.S. National Highway Traffic Safety Administration states that nearly half of all traffic-related fatalities occur in the dark, despite only 25% of traffic travelling during darkness.

Rather than the mechanical linkages employed in earlier directional-headlamp systems, AFS relies on electronic sensors, transducers and actuators. Other AFS techniques include special auxiliary optical systems within a vehicle's headlamp housings. These auxiliary systems may be switched on and off as the vehicle and operating conditions call for light or darkness at the angles covered by the beam the auxiliary optics produce.

6.1 Model Layout

Figure 8. Model headlight assembly

VII. DESIGN CALCULATIONS

7.1 Design Of Spring

Mean diameter of spring, D = 37.5mm
Maximum load on spring, P = 450N
Deflection of the spring, y = 12.5mm
Working stress = 300N/mm^2
Rigidity modulus, G = 0.8x 10^{5}N/mm^2

Size of the wire:

$\tau = K_s (8PD/\mu d^3)$

$300=1(8x450x37.5)/(\pi x d^3)$

$D^3 = 143.239$

D=5.2mm

Number of coils used:

Deflection, y = (8PD^{3}n/Gd^4)

$= (8x450x37.5^3xn)/(0.8x10^5x5.3^4)$

$N = (12.5x0.8x10^5x5.3^4)/(8x450x37.5^3)$

N = 4.156 say **N = 5**

Therefore ,
Total number of coils is 5+2**= 7**

7.2 Design Of Pinion:

Z_1=25
N_1=1200rpm
N_2=200rpm
M= 4 mm

Gear ratio:

$I= N_1/N_2$ = 1200/200 **= 6**

$Z_2 = 6 \times Z_1 = 6 \times 25$= **150**

The center distance, C:

$C = m (Z_1 \times Z_2)/2$ = **350 mm**

Tangential and transverse forces

$P = (F_t \times \nu)$

$F_t = P/\nu$

$= (5x10^5)/5.655$

Ft = 884.19 N

The transverse force, F_r

$F_r = F_t \times \tan\Theta$

= 884.19xtan20

Fr = 321.82 N

VIII. CONCLUSION

Due to the steering the head light tilts with the rotation of the steering about 20 degree , the Gear mesh is mounted on the cam plate with the link mechanism due to this links the head lights gets tilted in right direction if the steering is rotated in right side or vice-versa. This is been implemented in BMW, AUDI Q7, BENZ etc. The advantage is that road accidents can be avoided if we are in a new place & the weather condition is dark during day time & we no need to know the path well enough damages are around so, we can avoid the accidents and it gives more comfortable to us.

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