

## Regenerative Steering Operated Directional Headlights

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### ABSTRACT

*The topic of this project is steering controlled headlights, that are usually a separate set of headlights fitted to road vehicles beside the usual low beam/high beam headlights and their feature is that they turn with the steering, so that the driver of the vehicle can see the bend, what he is actually turning into. This project is to make new and modern 'Directional Headlights' in efficient manner by increasing the light angle so that the lights will follow the movement of the front wheels.*

### INTRODUCTION

The project is mainly to generate electricity when steering wheel is operated. Here steering wheel is coupled with a generator by means of bevel gear arrangement where vertical motion is converted to horizontal motion. The generator is connected to geared motors that drives the head lights and simultaneously the head lights. The power generated is used to store charge in Super Capacitor. This project uses DC generator, geared motor in it which provides sufficient torque to move the Head Lights. The power required for the motor, controller, Head Lights is provided from Generator/Super Capacitor source.

The aim is to design and develop a "Regenerative Steering Controlled Headlight Mechanism with Super Capacitor" which acts as directional headlights. This is done by connecting headlights and steering. Present day automobiles don't have effective lighting system.

Due to this many accidents are taking place during night times especially in hilly areas. The accidents can be avoided by incorporating Steering Control Headlight Mechanism.

The rack and pinion steering gear mechanism is used for this project. When the steering wheel is rotated and rotary motion is converted to translatory motion through the rack and pinion mechanism. When the front wheels are steered, the headlights follow's the same path and the light is focused on more divergent area. Simultaneously a bevel gear attached to the steering is coupled with a generator motor generate electricity and rotate the motors with head lights. In the present project, it is planned to design "Regenerative Steering Controlled Headlight Mechanism with Super Capacitor" and a live model unit is fabricated.

### PROBLEM DEFINITION:

A four wheeler usually find difficulty to drive especially at sharp turn. The present model helps them to change the focus of headlight as the steering move on either direction by regenerative method. Adaptive headlights react to the steering system of the car and automatically adjust to illuminate the road wheel. Turn the car left, the headlights angle to the left. The head lights are moved to direct a beam in the same direction as the movement of the vehicle. The power required to move the head lights is transmitted by generating power from the steering system coupled with a bevel mechanism.

## LITERATURE SURVEY

### CASE STUDY: 1 YMCA UNIVERSITY, FARIDABAD

Based on STEERING CONTROLLED HEADLIGHTS project report by YMCA UNIVERSITY of Science and Technology, FARIDABAD, the following mechanism was followed:

This project comprises Cam and Follower mechanism, Gear mechanism and spring mechanism. Cam and Follower mechanism is used to turn the head lights to right or left direction, Gear mechanism is used to transmit motion and to reduce the no. of rotations from steering rod to cam shaft. Spring mechanism is used to bring back the follower and head light bracket to its initial position.

According to this project, when the steering steers to the right, the light bracket at right alone steers to right using cam & follower mechanism and reduction gears & vice versa. At the same time the left bracket remains stand still due to the dwell period of the cam. During the return stroke of cam, the spring mechanism is used to bring the bracket and follower to its initial position. The reduction gears are used to turn the brackets to the required angle respective to the steering rotation.

INITIAL HEADLIGHT POSITION



FINAL HEADLIGHT POSITION



**Fig. 2.1 Direction of Headlight movement**

### CASE STUDY: 2 INTERNATIONAL JOURNAL OF INNOVATIVE AND EMERGING RESEARCH IN ENGINEERING

In this system we have mounted two clamps C1 and C2 on rack as shown in figure. Two connecting rods are mounted between each headlight and each clamp. Connecting rods are pivoted at clamp end and are simply supported in the slots of headlight back plate. Here in each back plate of headlight one slot is provided for desired movement of headlight. Headlight back plates are pivoted on two vertical rods to have an angular movement.

In this mechanism, when driver rotates steering left or right this motion is transmitted to pinion through steering shaft and universal joint. Rotary motion of pinion is converted into linear motion of rack. It causes clamps to move linearly with rack.

Connecting rods are having rotary motion at pivoted end and having sliding motion in slots at other end. Back plates of headlight have rotary motion on pivoted rods.

So, when we move steering left the connecting rod the left side pulls the left back plate and causes the headlight to turn left on pivoted rod and vice versa.



**Fig. 2.2 Arrangement of Directional Headlights**

## SYNTHESIS OF REGENERATIVE STEERING MECHANISM

Rack-and-pinion steering is quickly becoming the most common type of steering on cars, small trucks and SUVs. It is actually a pretty simple mechanism. A rack-and-pinion gear set is enclosed in a metal tube, with each end of the rack protruding from the tube. A rod, called a tie rod, connects to each end of the rack. The pinion gear is attached to the steering shaft. When you turn the steering wheel, the gear spins, moving the rack. The tie rod at each end of the rack connects to the steering arm on the spindle.

The rack-and-pinion gear set does two things:

- 1) It converts the rotational motion of the steering wheel into the linear motion needed to turn the wheels.
- 2) It 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).

3) Linkages are used to link between steering and rack and pinion links that helps to move the wheels.

4) The wheel spindle assemblies is the linkages and the fixings between the wheels and linkages (Not Arranged in this model)

5) Bevel Gear Mechanism is used to couple with the generator that generates electricity and is used to operate the motors with headlights.

6) Head Lights with Motor Mounts helps in the rotation of the head lights.

7) Generator Motor helps to generate the electricity and used to drive the motors.

8) Connecting Wires used for connecting between generator super capacitor and head lights.

9) Super Capacitor is used to store charge and utilize when there is no motion.

## METHODOLOGY

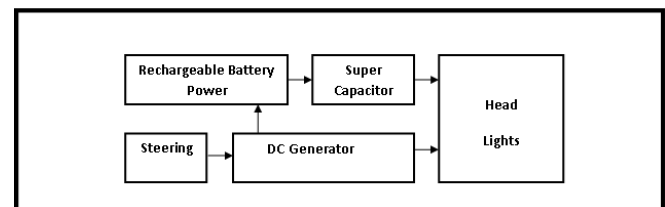
The Regenerative Steering System incorporates:

- 1) Steering wheel and column
- 2) A manual gearbox a rack and pinion assembly
- 3) Linkages steering knuckles and ball joints
- 4) The wheel spindle assemblies
- 5) Bevel Gear Mechanism
- 6) Head Lights with Motor Mounts
- 7) Generator Motor
- 8) Connecting Wires & Miscellaneous
- 9) Super Capacitor

The process here is all about regenerative steering system with moveable headlights with latest technology. 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, it containing a bevel gear mechanism that is used to generate power that drives the head lights to and fro depending on the movement of the steering. It contains universal joints to allow it to deviate somewhat from a straight line. Rack and pinion steering gear mechanism where the steering wheel turns the pinion. The pinion moves the rack, which is a linear gear. The bevel gear helps in converting vertical to horizontal motion and generate power that drives the motor and the headlights via super capacitor.

In this concept of mechanism super capacitors is used to replace batteries. The Capacitors is charged by means of power that is generated by generator. These are charged by means of a controller circuit. The steering when turned left and right it will generate power that drives the motors making the head lights to rotate to and fro. The charge generated is used to store it in the battery (Super Capacitor) that is being utilized by the head lights and by the motor.

## BLOCK DIAGRAM:



**Fig.4.1: Block Diagram of Regenerative Steering Operated Directional Headlights**

## DESIGN CALCULATIONS

Bevel Gear:

No of Teeth's- 24 Teeth mounted on the Steering

16 Teeth mounted on the Generator

Ratio of 3:2, so for every two cycles of rotation there will be three turns on the Generator.

Formulas:

Pitch Diameter:  $D = N/P$

Diametral Pitch:  $P = N/D$

Number of Teeth:  $N$

Whole Depth:  $H_t = 2.188/P + .002$

Addendum:  $a = 1/P$

Dedendum :  $b = H_t - a$

Clearance:  $c = H_t - 2*a$

**Table 5.1: Bevel Gear Design Calculations**

Parameter	Pinion	Gear
Diametral Pitch (P)	1.4	1.4
Teeth (N)	16	25
Pitch Diameter (D)	11.42857	17.85714
Whole Depth (Ht)	1.56486	1.56486
Addendum (a)	0.71429	0.71429
Dedendum (b)	0.85057	0.85057
Clearance (c)	0.13629	0.13629
Circular Tooth Thickness (T)	1.12200	1.12200



Power Generated by the Generator is:

Average Voltage -----8Vamp

Current -----0.4Amp

Power = Voltage x Current

= 8x0

= 3.2 Watts

## Capacitor

The amount of energy that can be stored in a capacitor per mass of that capacitor is called its specific energy. Specific energy is measured gravimetrically (per unit of mass) in watt-hours per kilogram (Wh/kg).

The amount of energy can be stored in a capacitor per volume of that capacitor is called its energy density. Energy density is measured volumetrically (per unit of volume) in watt-hours per litre (Wh/l).

As of 2013 commercial specific energies range from around 0.5 to 15 Wh/kg. For comparison, an aluminum electrolytic capacitor stores typically 0.01 to 0.3 Wh/kg, while a conventional lead-acid battery stores typically 30 to 40 Wh/kg and modern lithium-ion batteries 100 to 265 Wh/kg. Super capacitors can therefore store 10 to 100 times more energy than electrolytic capacitors, but only one tenth as much as batteries.

## RESULTS

The effective Regenerative Steering Controlled Headlight with Super Capacitor was designed, based on Bevel Gear Mechanism that is use to drive the generator and generate electricity and rotate the head lights, to move the steering arm that gives predefined motion to wheel and headlights.

The head lights are powered by Super Capacitor replaced in place of a rechargeable battery. This is very important system, which help to move the headlight as per turn, right or left. And it can be help for making nation accidents free roads.

We observed that when the steering wheel is rotated through a certain angle towards right side of the driver, the head lights are tilted through certain angle between 0-20 degrees to the right with the help of different

linkages with respect to the steering wheel. The same features are observed when the steering wheel is turned to the left side.

## Angle determination

Two bevel gears in mesh is known as bevel gearing. In bevel gearing, the pitch cone angles of the pinion and gear are to be determined from the shaft angle, i.e., the angle between the intersecting shafts

**Table 7.1: Angular movement of headlights**

Angle of turning of Steering wheel X(degrees) -ve (left) +ve (right)	Angle of turning of headlight on left side(degrees) -ve (left) +ve (right)	Angle of turning of headlight on right side(degrees) -ve (left) +ve (right)
-180	-10	-6
-360	-22	-17
-540	-33	-28
0	0	0
180	6	10
360	17	22
540	28	33

## CONCLUSION

A four wheeler usually find difficulty to drive especially at sharp turn. The present model helps them to change the focus of headlight as the steering move on either direction by regenerative method. Adaptive headlights react to the steering system of the car and automatically adjust to illuminate the road wheel. Turn the car left, the headlights angle to the left. The head lights are moved to direct a beam in the same direction as the movement of the vehicle. The power required to move the head lights is transmitted by generating power from the steering system coupled with a bevel mechanism. This system helps to move headlights left or right as per requirement along with the turn and can help to reduce accidents at night on sharp turning and hilly areas. Headlights can be on without using battery by using super capacitor.

## ADVANTAGES

- It can be used to see the path near crossings.
- This system helps to move headlights left or right as per requirement along with the turn and can help to reduce accidents at night on sharp turning and hilly areas.
- Headlights can be on without using battery by using super capacitor.

### DISADVANTAGES

- The rotation of head lights depending on the rotation of the steering cannot be fine-tuned.
- Geared Motors and Head lights arrangement need to be serviced regularly.

### APPLICATIONS

- Used for heavy vehicles in hill areas where hair-pin bends are more.
- Can be used in tempo, van and cars also.

### SCOPE OF FUTURE WORK

- The present regenerative can be upgraded by using gyro sensors to precise the functions up to degrees.
- This can also be upgraded by using angle sensors on the steering system.
- New sensory systems and sensory fusion is to be explored to plug additional information to the control system.
- This work can be extended to include different maneuvers to make the driving system capable of dealing with all driving environments.
- Future issues may also include an algorithm for autonomous formation of the cooperative driving. Thus, with the current and growing awareness of the importance of security, trustworthy vehicle autonomous systems can be deployed in few years

### REFERENCES

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