International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 07, July-2015

Development of Mechanism for Road Spike System

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Abstract **- Industrialization and modernization has led to advancements in the field of automobiles. This has eventually led to increase in production rates of vehicles for satisfying the demands for the customers. The ever increasing production rates are thereby contributing to large extent for traffic problems all over world. Managing this traffic has become a global concern. This has led to wasting time of motorists and passengers ("opportunity cost"). As a non-productive activity for most people, congestion reduces regional economic health. Delays, which may result in late arrival for employment, meetings, and education, resulting in lost business, disciplinary action or other personal losses. This project aims to serve as a solution to traffic problems faced in urban cities. For this "Road Spike System" has been developed which probably helps to control the traffic. The system consists of knife edge elements arranged in series. It punctures the tyres if vehicle tries to cross the traffic signal. The unit consists of cam operated mechanism.**

Keywords—Synchronous motor, Micro switches, Cam, Bearing, Shaft, Spikes.

I. INTRODUCTION

Need of Project: Traffic congestion

Anyone living in a populated area suffers from traffic congestion. Traffic is time, energy, and patience consuming. This has motivated people to regulate traffic flow in order to reduce the congestion. The idea is simple: if vehicles are allowed to go in any direction, there is a high probability that one will obstruct another. To avoid this, rules have been introduced to mediate between the conflicting vehicles, by restricting or bounding their behaviour. People have agreed on which side of the street they will drive (left or right); traffic lanes prevent cars from taking more space than necessary; traffic signals and codes prompt an appropriate behaviour; and traffic lights regulate the crossing of intersections. There is no solution to the traffic congestion problem when the car density saturates the streets, but there are many ways in which the car flow can be constrained in order to improve traffic. Traffic lights are not the only component to take into account, but they are an important factor. We can say that a traffic light system will be more efficient if, for a given car density, it increases the average speeds of vehicles. This is reflected in less time that cars will wait behind red lights

Causes

Traffic congestion occurs when a volume of traffic or modal split generates demand for space greater than the available road capacity; this point is commonly termed saturation. There are a number of specific circumstances which cause or aggravate congestion; Most of them reduce the capacity of a road at a given point or over a certain length, or increase the number of vehicles Required for a given volume of people or goods. About half of U.S. traffic congestion is recurring, and is attributed to sheer weight of traffic; Most of the rest is attributed to traffic incidents, road work and weather events. Traffic research still cannot fully predict under which conditions a "traffic jam" (as opposed to heavy, but smoothly flowing traffic) may suddenly occur. It has been found that individual incidents (such as accidents or even a single car braking heavily in a previously smooth flow) may cause ripple effects (a cascading failure) which then spread out and create a sustained traffic jam when, otherwise, normal flow might have continued for some time longer.

Negative impacts

Traffic congestion has a number of negative effects:

Wasting time of motorists and passengers ("opportunity cost"). As a non-productive activity for most people, congestion reduces regional economic health. Delays, which may result in late arrival for employment, meetings, and education, resulting in lost business, disciplinary action or other personal losses.

Inability to forecast travel time accurately, leading to drivers allocating more time to travel "just in case", and less time on productive activities. Wasted fuel increasing air pollution and carbon dioxide emissions owing to increased idling, acceleration and braking. Wear and tear on vehicles as a result of idling in traffic and frequent acceleration and braking, leading to more frequent repairs and replacements. Stressed and frustrated motorists, encouraging road rage and reduced health of motorists Emergencies: blocked traffic may interfere with the passage of emergency vehicles travelling to their destinations where they are urgently needed. Spill over effect from congested main arteries to secondary roads and side streets as alternative routes are attempted ('rat running'), which may affect neighbourhood amenity and real estate prices. Higher the chance of collisions due to tight spacing and constant stopping and going.

For this "Road Spike System" has been developed which probably helps to control the traffic. The system consists of knife edge elements arranged in series. It punctures the tyres if vehicle tries to cross the traffic signal. The unit consists of cam operated mechanism. In this project, development and analysis of selected components of road spike system is carried out.

II. ROAD SPIKE SYSTEM

A. Consruction and Working

It consists of following parts: Synchronous Motor, Micro switches, Shaft, Cam, Follower(Bearing), Spikes, Support structure(Horizontal and vertical plates, C-sections)

The working of the circuit has been done using normally open switches, for ease of demonstration.In actual practice it would be actuated using a micro controller AT89S51 which controls the traffic signal.

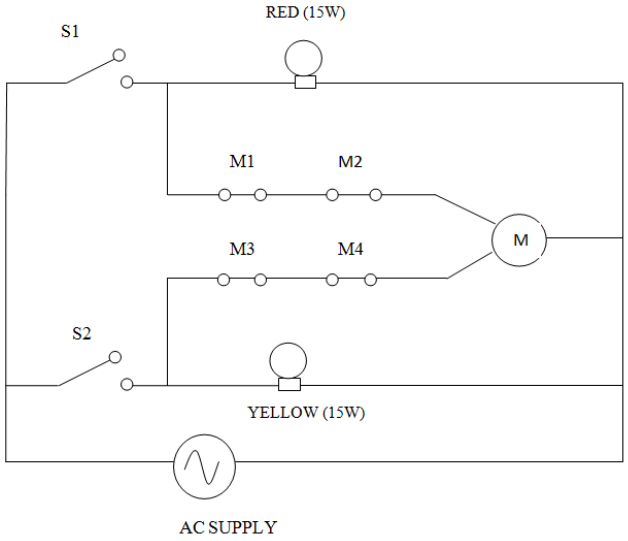

Fig 1. Working diagram

Case 1: When the signal changes to red

When the red switch is pressed it closes the switch S1 while switch S2 remains open. When switch S1 is activated it simulates a red signal which runs two parallel circuits one which switches on the red light and the other which activates the motor , the motor circuit has limit switches M1 and M2 (normally closed) in series with the motor. When the red light is ON the motor rotates in a anticlockwise direction (when viewed from the motor to the model).The motor is geared to a shaft on which lies a circular cam with a gear reduction of 5:1 hence the motor torque which is 10kg-cm gets multiplied 5 times and the speed of the shaft is reduced from the motor speed of 60 rpm to 12 rpm .The cam rotates such that it allows the shaft carrying the dead weight to come down smoothly. The downward motion of the dead weight shaft causes the spikes fixed to its end to rise above the road level. The spikes rise until they get locked in place by the backup plate. By the time the spikes reach the backup plate the circuit is the broken by the micro switches which are normally closed but open the circuit in activation. This prevents further rotation of the motor as these micro switches (M1 and M2) are in series with the motor. When the limit switches are activated it breaks the circuit causing the motor to stop rotating but the red bub in parallel with the motor continues to glow as long as the switch S1 is pressed.

Case2: When the signal changes to amber.

When the amber switch is pressed it closes the switch S2 while switch S1 remains open . When switch S2 is activated it simulates amber signal which runs two parallel circuits, one which switches on the amber light and the other which activates the motor. The motor circuit has limit switches M3 and M4 (normally closed) in series with the motor. When the amber light is ON the motor rotates in a clockwise direction (when viewed from the motor to the mode). The motor is geared to a shaft on which lies a circular cam with a gear reduction of 5:1 hence the motor torque which is 10kg-cm gets multiplied 5 times and the speed of the shaft is reduced from the motor speed of 60 rpm to 12 rpm. The cam rotates such that it allows the shaft carrying the dead weight to move up smoothly. The upward motion of the dead weight shaft causes the spikes fixed to the shaft to lower below the road level. The spikes lower until they reach below the ground surface. By the time the spikes reach the ground level the circuit is the broken by the micro switches which are normally closed but open the circuit in activation. This prevents further rotation of the motor as these micro switches (M3 and M4) are in series with the motor. When the limit switches are activated it breaks the circuit causing the motor to stop rotating but the amber bulb in parallel with the motor continues to glow as long as the switch S2 is pressed.

Case 3: When the signal changes to green.

During the red signal the spikes rises above the road surface and during the amber signal the spikes lowers below the road surface and stays stable throughout during the green signal. Hence during the green signal there would be no change in the system that is both the witches S1 & S2 remain open during the green signal

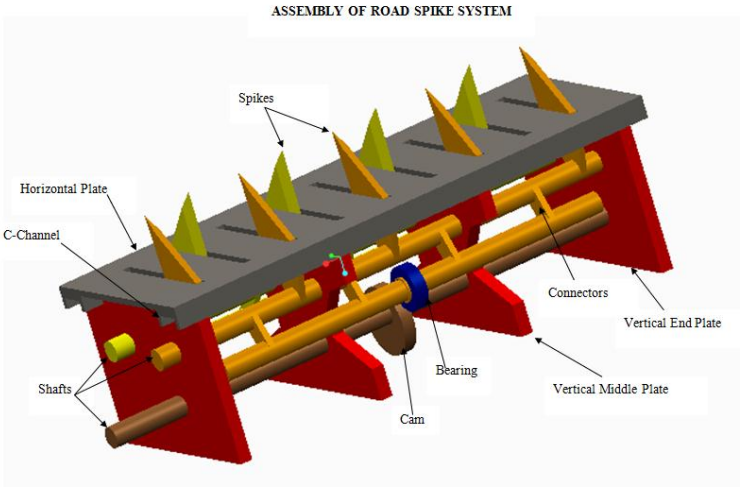

Fig 2. Assembly diagram

B. Material Selection

Materials are selected on the basis of four general criteria: Performance characteristics (properties), Processing characteristics (manufacturing), Environmental profile, Business consideration.

So, based on the criteria and the specification we need for our design which is a material with high weight to strength ratio, available in the market, and have a competitive value. After searching for the perfect material we found out that the best material to use in manufacturing our parts is mild steel.

Mild steel, also known as plain-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low-carbon steel contains approximately 0.05–0.15% carbon making it malleable and ductile. Mild steel has

a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm3 (7850 kg/m3 or 0.284 lb/in3)[4] and the Young's modulus is 210 GPa (30,000,000 psi).

Low-carbon steels suffer from yield-point runout where the material has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If low-carbon steel is only stressed to some point between the upper and lower yield point then the surface may develop Luder bands. Low-carbon steels contain less carbon than other steels and are easier to cold-form, making them easier to handle.

III. SELECTION OF CAM AND FOLLOWER

Radial cam is selected for proposed system due to following reasons,

1. The functional requirement was such that the follower must move in a plane perpendicular to the axis of rotation of the camshaft. This is fulfilled by radial cam only.
2. Ease of manufacturing as it is simple in construction.
3. It is less costly.

Roller follower is selected for proposed system due to following reasons,

1. No wear and tear
2. Easy to manufacture
3. Simple in construction
4. It fulfils functional requirement

Gravity type of constraint of the follower is selected for proposed system due to following reasons,

1. It is least expensive unlike positive drive cam.
2. It does not wear unlike preloaded spring cam.
3. It is reliable since it works on principle of gravity.
4. The only disadvantage is it increases the weight.

IV. CONCLUSION

At the outset of the project, the Road Spike System was chosen as the most suitable conceptual design for satisfying the problem statement. Consequently, the main objective module was to Develop a mechanism for Road Spike System. The module was concluded successfully and the result was a suitable design satisfying the earlier demands. The mechanism was developed on the basis of the Rule of Thumb and ease of manufacturing, availability of components at short lead times.
One more aspect of the project was to reduce the traffic management problem and inculcate behavior of following traffic rules and regulations in citizens. The machine is also important from the point of view of security application to the potential customers.
Thus, the project was concluded to be successfully and beneficial for the overall development of both the society and the students.

ACKNOWLEDGMENT

To put an effort like this requires the determination and help of many people around me and I would not be doing justice to their efforts by not mentioning each helping hand in person. First of all, I express my heartfelt gratitude to Dr. H. V. Vankudre, Head of Department and other staff member of the mechanical engineering department for their kind co-operation.
I feel privileged to acknowledge with deep sense of gratitude to my guide Prof. T. A. Jadhav, for his valuable suggestion and guidance throughout my course of my studies and help render to me for the completion of the report. I would like to give sincere thanks to the central library cell and reference library cell and information access centre for their kind co-operation throughout my work. Last but not the least; I would like to thank my parents and my friends. It would have not been possible to complete the report without their moral support, valuable comments and suggestion which motivated me towards work.

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