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Electro-Mechanical Speed Governing Accident Avoidance System in Automobiles

Prathamesh Patil¹, Aditya Shinde², Abhishek Mhangore³, Sandesh Pol⁴, Prashant Maske⁵

U.G. Student, Department of Mechanical Engineering, PCET'S NMIET College, Pune, Maharashtra, India¹

U.G. Student, Department of Mechanical Engineering, PCET'S NMIET College, Pune, Maharashtra, India²

U.G. Student, Department of Mechanical Engineering, PCET'S NMIET College, Pune, Maharashtra, India³

U.G. Student, Department of Mechanical Engineering, PCET'S NMIET College, Pune, Maharashtra, India⁴

Professor, Dept. of Mechanical Engineering, PCET'S NMIET College, Pune, Maharashtra, India⁵

ABSTRACT: As far as automobiles are concerned, safety is extremely important to avoid the occurrence of accidents. It minimizes the loss of property and life. The recent surveys, in the past few years, an accident near the areas like college/school, hospital zones and sharp turnings have increased tremendously, due to their hurry to reach the targeted place soon. Therefore, controlling vehicle speed on respected lanes has been an important issue to be considered. This paper aims to provide a practical, compact and simple design to develop an automatic vehicle speed control system, which must be implemented in automobile to minimize the accidents. This technique consists of electronic proximity sensor and over speed sensing mechanism, the proximity sensor as the name suggests senses the proximity of the spring when it is out of the range of sensor and further brakes are applied. The proximity sensor is connected to the electronic relay and therefore the power source. Once this method is implemented the accidents are going to be reduced on a larger rate, and also reduce the nuisance by some drivers.

KEYWORDS: Automatic vehicle speed control system, electronic proximity sensor, Electronic relay, Braking System.

I. INTRODUCTION

The Indian Law Commission has an advisory to limit the speed, to reduce the road accidents and to make a peaceful environment for the people. The existing methodologies can't able to reduce the accidents still now, Because of the rash driving of some drivers. Hence speed control is in need to be implemented in all the vehicles. Here is the new idea of ours to install an automated speed control system in the vehicles. Electro-mechanical speed governing system is basically a system that can be in an automobile which automatically decelerate the speed of the vehicle when its speed crosses the speed limit of that lane. Therefore this system controls and monitors the overall vehicles in its covered area. By implementing this system the accidents are reduced in this fast-moving world. In the developed and developing countries, people finds inconvenience with the road accidents, jamming of vehicles because of the drivers who dislike to obey the laws at the restricted zone, where the speed has to be limited as prescribed in that zone by using an automated speed control system to limit the speed automatically.

This speed governor system is cost efficient and can be installed in economic vehicles. The components used in the system are cheap and simple and does not contain any computing devices and microprocessor. It is a simple mechanical system with high accuracy. By further research it can be used to maintain the speed of the vehicle in different lanes and at restricted zones like schools/colleges and sharp turns and fines can also be implemented on the vehicle if speed limit is crossed multiple times.

II. METHODOLOGY

Large number of accidents are caused due to over speeding and there are various methods invented to avoid such tragedies. But these systems are too costly and are not affordable. Hence me and my team designed a system that is cheap and can be implemented in low-cost vehicles. In this system, we have used a proximity sensor and designed a governor in such a way that when the speed of the vehicle exceeds its permissible limit the proximity sensor senses the spring and hence brakes are applied.

III. CONSTRUCTION

The electro-mechanical speed governing accident avoidance system comprises of the following:

- a) Chassis or Frame: The chassis or frame is fabricated structure that carries the whole system rear wheel shaft is the driver shaft, that carries the pulley driven by motor utilizing a belt drive. The end carries the steering mechanism.
- b) Motor: Motor used is single phase AC motor 50 watt, 0 to 6000 rpm variable speed.
- c) Over speed Sensing mechanism : The over speed sensing mechanism is a mechanical linkage supported on the centrifugal force , because to centrifugal force the springs will get away from the sensor and this sensor will sense that and further apply brakes.
- d) Electronic Proximity sensor: The electronic proximity sensor is mounted on the frame. The proximity sensor as the name suggests senses the proximity of the spring and hence brakes are applied.
- e) Electronic relay – The main motive to use electronic relay is to regulate and control the current flow in sensor and switch.
- f) Electronic Speed Regulator - It is an electronic circuit that controls and regulates the speed of electrical motor.
- g) Braking Mechanism: Disk brake is used in the braking mechanism. The Disk brake is utilized with the view to maximise the braking and ensure safety.
- h) Over speed indicator lamp and or Hooter: This is used for indication or alarm system, the lamp is an red LED lamp that flashes when over speed occurs , hooter and horn is used as a buzzer arrangement that is switched on when speed is exceeded above permissible limit there by alarming the driver.

IV. WORKING

System starts with motor starting. Motor speed controlled by electronic speed regulator as speed increases the weight of the centrifuge fly's out making the spring get away from the sensor hence resultant gap between spring and the proximity sensor exceeds the maximum speed limit which makes the relay to operate and consequently the following actions take place.

- a) Visual over speed indicator in the form of over speed indication lamp lights.
- b) Audio over speed indicator in the form of over speed indication hooter goes ON.
- c) Brakes are applied to the wheels.

Design of governor:

Here the approach is to select the spring directly as per geometrical constrains and calculate the mass of the centrifugal bob weights to deflect the spring according to requirements of the governor set-up

Assuming minimum cut off speed for model = 60 kmph

Wheel diameter = 300 mm

Hence speed of wheel shaft = 1060 rpm

Radial speed = $\omega = 111$ rad/sec

According to the Geometry of setup the spring used in the governor setup is mounted on the wheel shaft, hence minimum diameter = 16 mm, assuming rod diameter = 1.2 mm and no. of turns to be 10, both end ground, free length = 20mm.

The function of the spring is to maintain the gap between the sensor and the probe below 3mm, hence in order to cut-off to occur the spring has to be deflected by at least 4mm.

Hence specifications of spring selected:

Type: Helical compression spring:

End condition: Both end ground

Rod diameter = 1.2 mm

Inner diameter of spring = 16mm

Outside diameter of spring = 18.4mm

Mean coil diameter = 17.2mm

Free length = 20mm

No of turns = 10mm

Hence solid length = 12mm

Maximum deflection possible = 8 mm

Spring index = 15

Maximum permissible stress = 420 N/mm²



Modulus of rigidity = 84 KN/mm²

$$F_s = \frac{K \times 8 \times WC}{\pi d^2}$$

$$420 = \frac{1.123 \times 8 \times W \times 15}{\pi \times 1.22}$$

$$W = 14.09 \text{ N}$$

This is the load in the axial direction to be applied by the flying bob weight as centrifugal force, so also the friction in linkages and shaft sliding bearing has to be overcome by the mass system hence; the load is taken to be 2 times required

$$W = 2 \times 14.09 = 28.18$$

$W = m\omega^2 r$ -----This is because two bob-weights are used.

$$m = 28.18 / \omega^2 r$$

$$m = 28.18 / 1112 \times 0.025 = 0.092 \text{ N}$$

$$m = (0.092 / 9.81) \times 1000 = 9.4 \text{ g}$$

Material Selection: -Ref: - PSG (1.10 & 1.12) + (1.18)

Aluminium

Ultimate tensile strength = 480 N/mm²

Yield strength = 320 N/mm²

As per ASME code $F_{smax} = 18 \% \text{ of UTS} = 0.18 \times 480 = 86.4 \text{ Mpa}$

$f_s \text{ max} = 144 \text{ N/mm}^2$

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

$T_{\text{design}} = 0.95 \text{ Nm}$

$$T_d = \pi/16 \times f_s \text{ act} \times (D_4 - d_4) / D$$

$$f_s \text{ act} = \frac{16 \times T_d}{\pi \times (D_4 - d_4) / D}$$

$$\pi \times (D_4 - d_4) / D$$

Outside diameter of governor boss = 32 mm

Inside diameter of governor boss = 16mm

$$= \frac{16 \times 1.9 \times 10^3 \times 32}{\pi \times (32 - 16)}$$

$$\pi \times (32 - 16)$$

$$f_s \text{ act} = 0.1574 \text{ N/mm}^2$$

As $f_s \text{ act} < f_s \text{ all}$

Governor body is safe under torsional load.

Hence the profile of bob weight selected is as follows:

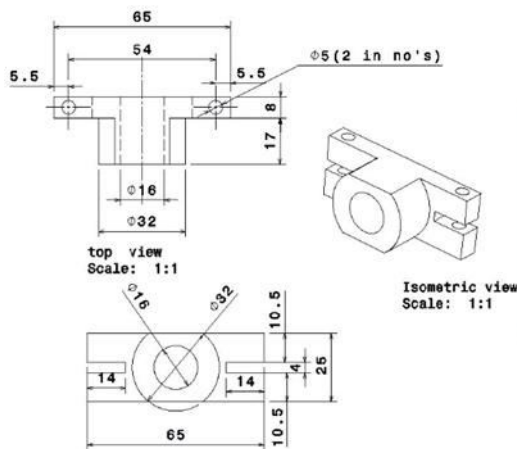


Fig.-1 Governor

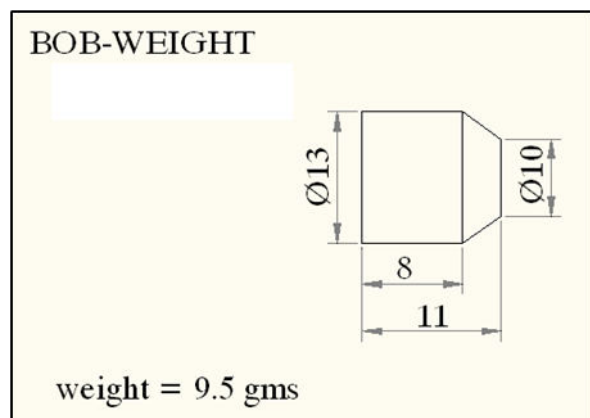


Fig.-2 Bob weight

Design of link:

The link that is subjected to direct tensile load in the form of pull = 28.18 N

The cross sectional area of link is 10 x 2 mm²

Material Designation – C40 Carbon steel

REF:-PSG DESIGN DATA (1.10&12 1.17)

Tensile strength = 600 N/mm²

Yield strength = 380 N/mm²

a) Check for failure of connecting rod under direct tensile load

Now,

$$F_t = \text{Load} / \text{Area}$$

$$F_{t \text{ act}} = 28.18/20$$

$$= 1.409 \text{ N/mm}^2$$

As $F_{t \text{ act}} < F_{t \text{ all}}$

The link is safe under tensile load

b) Check for failure of link under direct tensile load at the eye end

This is the portion where the lever pin fits, The cross sectional area at this point is $10 \times 2 - 4 \times 2 = 12 \text{ mm}^2$

Now,

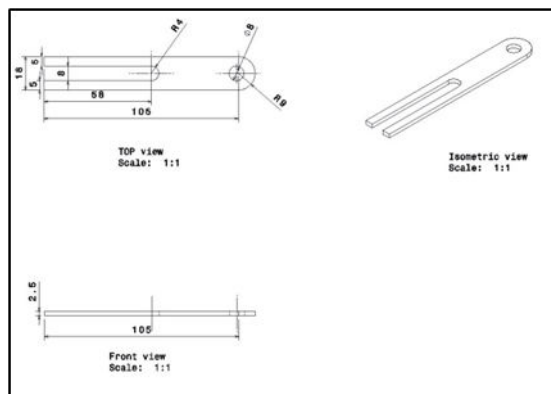
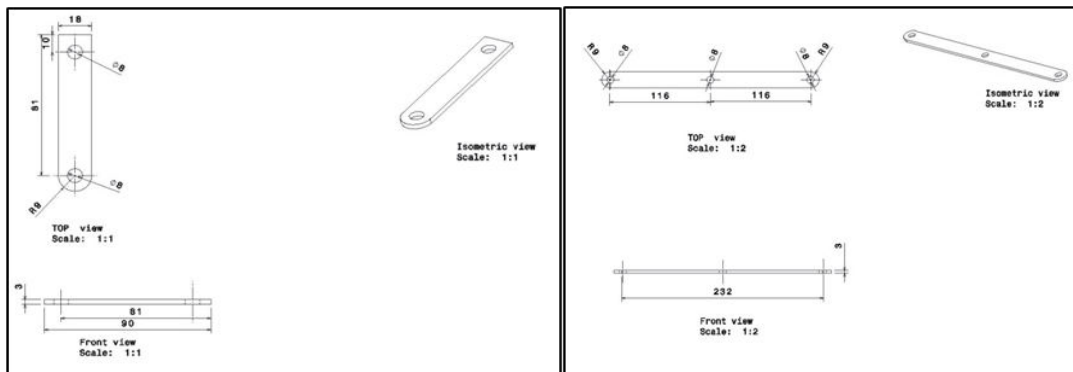
$$F_t = \text{Load} / \text{Area}$$

$$F_{t \text{ act}} = 28.18/12$$

$$= 2.34/\text{mm}^2$$

As $F_{t \text{ act}} < F_{t \text{ all}}$

The link is safe under tensile load

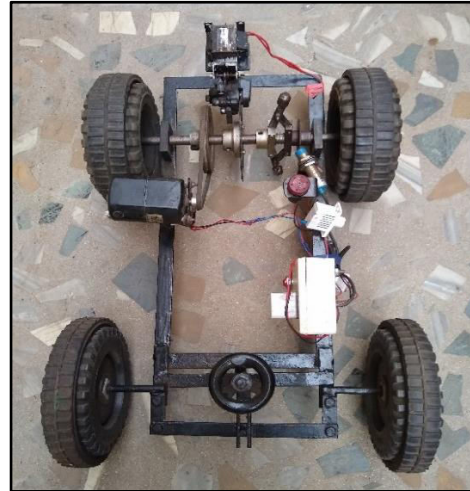
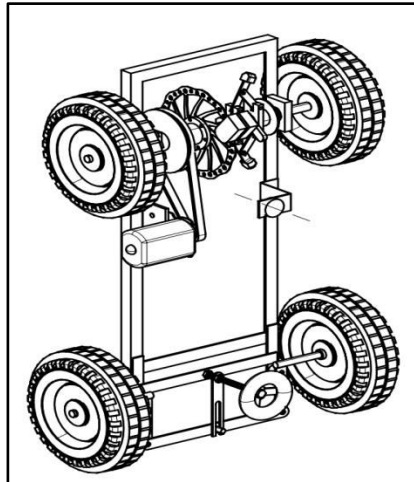


V. CONCLUSION

- 1) This system will control the speed of the vehicle and won't exceed the speed above the permissible limit by applying the brakes.
- 2) This system is inexpensive and affordable; this system can be implemented in an economical vehicle.

3) This mechanical system can be implemented easily in automobiles.

FINAL DESIGN



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