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Research Article

Design and Fabrication of Automatic Brake in Vehicle

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Abstract

In this project work the design and construction of a model of automatic braking system for vehicles in hill station is to be developed. The mechanism has been developed to stop the vehicle from rolling back word when the vehicle is moving in the hill roads. This construction made of two phases in a first deigns of ratchet and pawl mechanism, frame, shaft, etc. is done and in second sensor selection and interference is done. Ratchet and pawl mechanism has been fabricated and assembly with sensor interface is tested. The proposed mechanism is to reverse break using ratchet gear. By reverse locking the differential is disengaged from the axle. Thus the power is directly transmitted to the axle and hence to the wheels. This will considerably reduce the power loss in some occasions when unwanted loss is happening due to the transmission if power from the shaft to the ratchet gear and then to the axle and hence to the wheels. So in mechanism the unwanted power loss in the due course of transmission through the gear wheel is reduced.

Keywords: *Ratchet, Pawl, IR sensor, Solenoid valve, Shaft, Automation, Braking System*

1. Introduction

In the inclination station, the most understood issue to the drivers is to stop their car on inclination and to go in a forward direction. While holding up in the action, the car needs to continue forward very much requested step by step, this situation is a trouble, someone, for the drivers to make their car not to move back in the grade. So the instrument must be made to keep the vehicle from moving back and it should not stop the vehicle from reviving advances. This limit can be proficient by using ratchet and pawl instrument. The ratchet and pawl must be arranged and should be fit in the rear drive shaft if they emerge and event of the rear drive vehicle.

Hill road ratchet and pawl mechanism are characteristic to arrest the motion to rear shaft anti roll back mechanism has been invented and tested on rear shaft assembly. The mechanism works well. Ratchet and pawl mechanism is employed in several applications effectively wherever the one during this work the mechanism has been developed to prevent them from rolling backward once the vehicle moving on the vehicle aspect power transmission is needed.

The proposed mechanism is to reverse brake using ratchet gear. By revers lockup the differential is disengaged from the shaft. This power is directly transmitted to the shaft and therefore to the wheels. This wheel significantly reduces the ability loss in some occasions once the unwanted loss is going on due to transmission if power from the shaft to the ratchet gear so to the shaft and thus to the wheels.

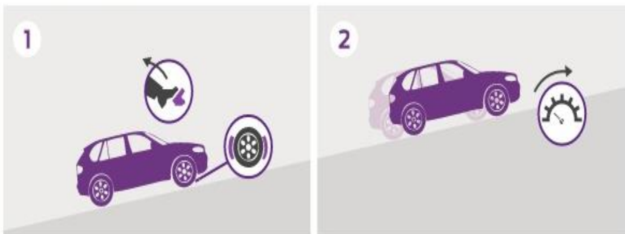

Fig.1 Application of brakes on slopes

1.1 Problem Statement

1) Sloppy area in hill station vehicle roll back while on driving or stationary position while rolling back vehicle may collide with behind vehicle, this causes accidents and loss of assets.
2) When vehicle is coming out from parking of mall the exit way was like 45° step. There is condition to applied clutch and brake because the vehicle ahead. But vehicle moves forward it was rolling back.
3) While a vehicle in normal surface when release the clutch with little or no acceleration because of that is enough for vehicle to move forward. But on

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slope there is zero or little acceleration is not enough that's why vehicle move backward.

1.2 Objectives

1) To design and fabrication a prototype model of showing the concept of automatic brake in vehicle while driving on slopes in hill station road conditions.
2) To fabricate the model of the same this will show the working desired by emergency braking on slopes in hill station road
3) To provide safety options while driving a vehicle on hill station.
4) To test the model under different condition of speed and slopes.

2. Literature survey

Cook George in Anti-creep and hill holder brake system paper has explained a hill holder mechanism holds the vehicle in slope for two seconds by using brake pressure. A tool operable in transmission of vehicle for substantially preventing conveyance roll back on associate on incline surface.

William Kent has explained in Improved released mechanism for a hill holder device utilized load sensor connected with the wheel brake to sense a change a wheel braking torque and communicate responsively with mechanical brake control device. If a car is stop on an incline while the motor still running, there's good chance that some kind of hill-start control will be needed. A sensor that detect an incline of more than certain amount, 3° or more, can send a signal to the hill start control indicating that the vehicle has the potential to start rolling.

Alvin H. Berger has explained in vehicle transmission hill holder paper a one-way clutch when engaged it prevents rolling of the vehicle. A device operable in a transmission for substantially preventing vehicular roll back on an inclined includes a shaft, gear, one-way clutch and pawl member. The gear is selectively connected for common rotation with shaft. The gear is rotatable in first rotary direction and second rotary direction. The one-way clutch has inner race and an outer race, where the inner race is connected to the gear and the outer race has an outer surface having a plurality of engaging teeth. The pawl member has a first end and a second end, where the first end in pivotal mounted to transmission housing. The second end of the pawl has a first angled portion configured to release the engage at least one of the plurality of engaging teeth of the outer race as the outer race rotates in the second rotary direction.

Roop Sing Takur, E. Ramkumar in Improving Quality of Vehicle Tracking System in Hill Station Using IEEE 802.16 Network paper has explained IEEE 802.16 standard was design to support the vehicle tracking system applications with quality of service (QOS). With the help of subscriber station (SS) can track the vehicles. Subscribers station's will provide signals to the mobiles and vehicles.

3. Working principle

The IR Transmitter circuit is to transmit infrared rays. If any obstacle is there on a path. The infrared rays mirror. These mirrored infrared rays are received by receiver circuit is named IR Receiver. The IR Receiver circuit receives the mirrored IR rays and giving the management signal to the negative feedback circuit. The negative feedback circuit is employed to activate the solenoid valve. If the solenoid valve is activated the compressed gas passes to the cylinder. The compressed gas activates the gas cylinder and moves the connecting rod if the piston moves forward, then the braking arrangement is activated. The braking arrangement is employed to brake the wheel gradually or suddenly as a result of piston movement the braking speed is varied by adjusting the wall is named flow management valve.

4. Calculations

1) Design of Frame

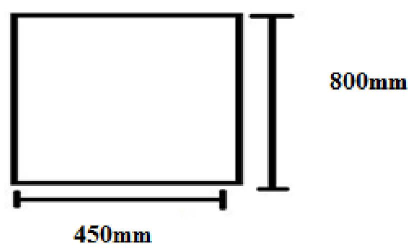

Fig. 2 Design of frame

Frame design for safety FOR 25*25*3 square angle mild steel channel
b = 25 mm, d= 25 mm, t = 3 mm.
Consider the maximum load on the frame to be 20 kg.
Max. Bending moment = force*perpendicular distance
= 20*9.81*400
M = 78480 Nmm
We know,

$M / I = \sigma b / y$

M = Bending moment

I = Moment of Inertia about axis of bending that is; Ixx
y = Distance of the layer at which the bending stress is consider
(We take always the maximum value of y, that is, distance of extreme fiber from N.A.)
E = Modulus of elasticity of beam material.
I = BD^3/12-bd3 /12
= 25*25^3 / 12 -19*19^3/12
I = 21692 mm4
σb = My / I
= 78480*12.5 / 21692
σb = 45.22 N /mm^2

The allowable shear stress for material is $\sigma all = Syt / fos$.
Where Syt = yield stress = 210 MPa = 210 N/mm^2
And fos is factor of safety = 2
So $\sigma all = 210/2 = 105$ MPa = 105 N/mm^2
Comparing above we get,
$\sigma b < \sigma all$ i.e 45.22 < 105 N/mm^2
So design is safe.

2) Design of Shaft

$$M/I = \sigma b/Y \quad (1)$$

Bending moment=force*perpendicular distance
=5*9.81*450
Bending moment =22072.5Nmm
for diameter 15mm,
I=π/64*d4
=π/64*154
I=2483.78 mm4
Therefore, using equation no. (1)
22072.5/5483.78=σb/7.5
σb = 8.86*7.5
σb =66.64 N/mm^2

3) Ratchet Design

The mechanism is designed for the loading conditions while applying brakes on slopes. The circumference of the front drive shaft of this car is measured and the diameter is determined as 23.89mm. The two primary failure modes for gears are:

1) Tooth Brakeage - from excessive bending stress, and
2) Surface Pitting/Wear - from excessive contact stress.

In both cases, we are interested in the tooth load, which we got from the torque, T. Recall that we compute the tangential force on the teeth as Wt. = T/r = 2T/D, where Dis the pitch diameter.
Ratchet design Standard dimension

Main dimensions of this is expressed with a pitch diameter is an imaginary circle that rolls without slipping as a point of meeting two tooth profile pairs. The tooth size is expressed by the pitch circle is the distance along the circle of the distance between two profiles of adjacent teeth. Pitch circle is a circle which has the radius of half the pitch diameter with its center at the axis of the gear. The relationship between pitch diameter and pitch circle can be seen by the following equation: Pitch circle formula for spur gear

D = Pitch Diameter (mm)
T = Number of Teeth

The tooth size may be determined from the amount of pitch circle, because the pitch circle is the circumference of a pitch divided by the number of tooth. However, because the pitch circle always contains π factor used as a dimension of the tooth is less convenient. To remedy this, take a measure called 'module' with the M symbol,

Module formula
M = Module
D = Pitch Diameter (mm)
T = Number of Teeth

Thus, M (module) can be specified as integers and fractions numbers of 0.5 and 0.25 are more practical. Therefore, π * M = C, the module can be used as size of the tooth.

Selection of the module will affect the gear strength, so election gear module must be in accordance with the power requirement and speed of pinion gear. The modules can be selected through the curve selection module below.

Design for Mechanical Strength - Lewis Equation

Now the major parameter remaining in gear design is width of the gear teeth, b. This is determined by checking whether maximum bending stress induced by tangential component of transmitted load, Ft at the root of gear is greater than allowable stress. As we know power transmitted and pitches line velocity V of the gear Ft can be determined using following relation.
One can easily find out maximum value of bending stress induced if all geometrical parameters shown in above figure are known. But the quantities t and l are not easy to determine, so we use an alternate approach to find out maximum bending stress value using Lewis approach. Maximum bending stress induced is given by

Lewis bending equation as follows

$$\sigma t = Ft*Pd/b*Y$$

Where,
σt = tangential bending stress in gear tooth
Ft- maximum allowable tangential force acting on tooth due to braking force as calculated above = 207.2 N
Pd = diametrical pitch of ratchet
b= face width of pinion = 10 mm
Y = Lewis form factor = 0.322 for 32 no. of teeth

Lewis form factor which is a function of pressure angle, number of teeth and addendum and dedendum. Value of Y is available as in form of table or graph. Using above relation one can determine value of b, by substituting maximum allowable stress value of material in LHS of equation. But a gear design obtained so will be so unrealistic, because in this design we are considering gear tooth like a cantilever which is under static equilibrium. But that's not the actual case. In next session we will incorporate many other parameters which will affect mechanical strength of the gear in order to get more realistic design.

Considering the tooth area of ratchet and the tangential load acting on tooth we can calculate the stress acting on tooth, as follows,

σt = Force/Area = F/A

F= tangential force acting of ratchet = 207.2 N

Area can be calculating as width of tooth and height of pawl tooth acting area = 3mm*4 mm= 12 mm

σt =207.2/12

= 20 N/mm2

σt = 17.26N/m2

σt = Ft*pd/b*Y

17.26 = 207.2*pd/10*0.322

Pd= 0.26mm

So the pitch circle diameter (D) is calculated from diametrical pitch as follows,

Diametrical pitch Pd = Number of teeth T / Pitch circle diameter

Pd = T/D

D =T/pd

D =32/0.26

D = 123 mm

The pitch circle diameter of ratchet is calculated to be 123 mm.

Module: Module is the unit of size to indicate how big or small a gear pinion is. It is the ratio of the reference diameter of the gear pinion divided by the number of teeth. Thus the formula of Module Calculation of gear pinion is:

Module (M) = Reference Diameter / Number of Teeth

Minimum no. of teeth = we take minimum number of teeth= T = 32

Module m = Diameter/no. of teeth

=123/32

= 3.84

m = 4

So selected module is 4

Module (m) = 4mm

Width of ratchet (b) = 10 mm

Minimum number of teeth on ratchet = 32

PCD of ratchet = 123 mm.

4. Pawl Design

Diameter of pawl (Do) = 10mm

Length of pawl (L) = 70 mm

Width of pawl = 10 mm

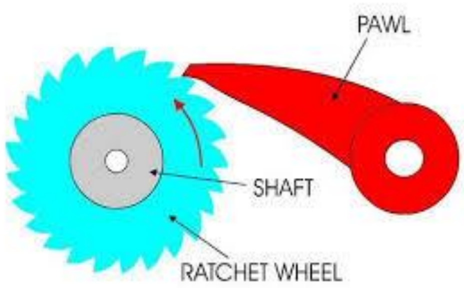

Fig.3 Schematic of Ratchet Pawl

5. IR Sensor

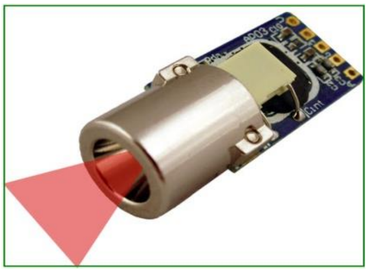

Fig.4 IR Sensor

6. Solenoid Valve

Fig.5 Solenoid DC valve

A solenoid valve is associate degree electro-mechanically operate valve. The valve is controlled by an electrical current through a magnet in the case of two port valve the flow is switched ON or OFF; within the case of three port valve, the outflow is switched between the two outlet ports.

Solenoid valve are the for most frequently used magnet parts in fluidics. Their tasks are to shut off, release, distribute or mixed fluids they are found in several application areas.

7. CATIA design

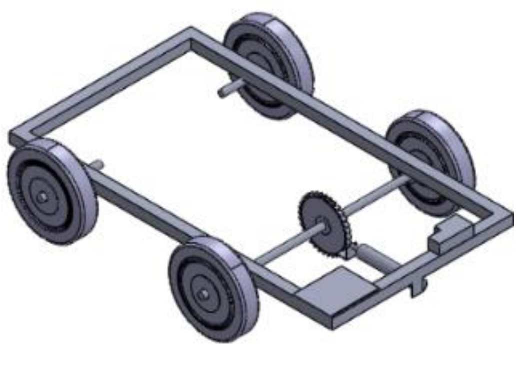

Fig.6 Catia design

8. Proposed model

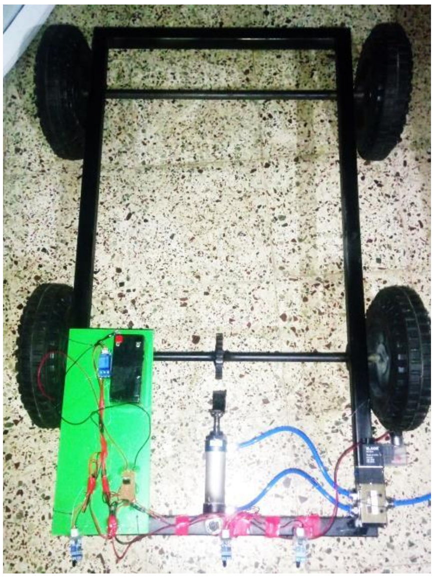

Fig.7 Proposed model

9. Advantages

i. Brake cost will be less.
ii. Free from wear adjustment.
iii. Less power consumption
iv. Less skill technicians are sufficient to operate.
v. It gives simplified operation.
vi. Installation is much simplified.

10. Applications

i. For automobile applications
ii. Industrial applications

11. Result

The system which is that the design and construction of an anti-collision system for vehicle was design considering some factor like economy and analysis of material, efficiency, compatibility, portability and additionally durability performance of the system when test met design specification the final operation of the system and performance release on the presence of moving vehicle because hybrid automotive developed by America is state of the art construct and behind these our endeavor is to project a fully auto hybrid automobile construct in India car market so the whole India in general and economic and rural community in India, in particular can be benefited.

Conclusion

The project Automatic Brake in Vehicle has been successfully design and tested. It has been developed by integrating features of all hardware components used. Presence of every component has been reasoned out and placed carefully those contributing to the best working of the unit.

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