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DESIGN AND FABRICATION OF ANTI SLIDING AND SLOPING SYSTEM IN VEHICLES USING RATCHET AND PAWL MECHANISM

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Abstract— In this work the mechanism has been developed to stop the vehicle from rolling backwards when the vehicle is moving in the hill roads. Ratchet and Pawl mechanism has been identified to arrest the motion to the front axle. Anti-Roll Back mechanism has been fabricated and tested on the front axle assembly. The mechanism works well.

Index Terms*-Ratchet, Pawl, Drive shaft, Hill Road*

I. INTRODUCTION

Ratchet and pawl mechanism is used in many applications effectively where the one side power transmission is required for example in (i) Giant wheel- It is the large wheel used in the amusement parks to rotate along the horizontal axis to rotate in one direction while carrying the number of passengers. (ii)Clocks- where the hands rotate in clockwise directions only.(iii) Baffle gates- in the entrances of many buildings which rotates about vertical axis in one direction.(iv) Shaping Machines – in the crank and slotted arm.

In the hill station, the most common problem to the drivers isto park their cars in the slope and to start up the car. While waiting in the traffic , the cars have to move on step by step very slowly, this situation is a difficult one for the drivers to make their car not to roll back in the slope. So the mechanism has to be developed to stop the vehicle from rolling back and it should not stop the vehicle in accelerating forwards. This function can be achieved by using the ratchet and pawl mechanism.

The ratchet and pawl has to be designed and has to be fit in the front drive shaft in case of the front drive vehicles. The and the ratchet and pawl has to be designed for it. In order to design for the worst case the road maximum slope is considered- Zoji pass Road Kashmir which has 21.80 ^{o} with gradient 2/5.

II. LITRATURE SURVEY

A. Anti-creep and hill holder brake system

Maruti Swift Dzire car is considered Cook George suggested a hill holder mechanism holds the vehicle in slope for 2 seconds by using the brake pressure. A device operable in a transmission of a vehicle for substantially preventing vehicular rollback on an incline, comprising: a shaft rotatable which is supported in a transmission housing; a gear selectively connected for common rotation with the shaft, wherein the gear is rotatable in a first rotary direction and a second rotary direction.

B. Improved release mechanism for a hill holder device

William kent utilized a load sensor connected with a wheel brake to sense a change in wheel braking torque and communicate responsively with a mechanical brake control device. If a car is stopped on an incline while the motor is still running, there's a good chance that some kind of hill-start control will be needed. A sensor that detects an incline of more than a certain amount, three degrees or more, can send a signal to the hill-start control indicating that the vehicle has the potential to start rolling. The disadvantage of incline detection is that sometimes a car maybe on an incline without needing the hill-start control - for instance, when a tire slips into a pothole.

C. Improved release mechanism for a hill holder device

Grzegorz Janiszewski stated that the use of piston cylinder device, controlled by an electronic unit which is coupled to a hydraulic pressure system and acts on the brake pedal for two seconds.

D. Release mechanism for a hill holder device

William K. Messersmith used the load cell with electrical control for braking system. But it requires continuous electric energy for the production and display of signals. It also requires an amplification circuit for the generation of output display because the signals produced by the gauge itself are of very much low voltage almost in milli-volts. In a vehicle having a clutch pedal and a brake pedal, a hill holder device is utilized to maintain the brake pedal in the applied position so that the vehicle operator's foot is free to operate the accelerator pedal. A mechanical brake control device may be disposed between the clutch and brake pedals, with the clutch pedal connected by a linkage to the brake control device so that release of the clutch pedal will cause deactivation of the brake control device and result in release of the brake pedal from the applied position. The release mechanism should be usable with either a mechanical brake control device or a braking assistance servo-motor system.

E. Vehicle transmission hill holder

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

III. RESEARCH GAP

The greatest disadvantage of hill holder mechanism is that it can hold the vehicle in the slope for just two to three seconds. Though it avoids rolling back, the driver has to be alert. Besides this, the system is expensive. These shortcomings are identified in hill holder mechanism and the following problems are faced by the driver while the vehicle is driven in hill roads

(i) Most of the drivers face difficulties while operating the brake, clutch and accelerator simultaneously while driving the car in hill roads.(Fig.1)

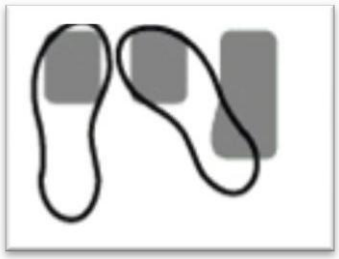

Figure 1: Schematic representation of operating the brake, clutch and accelerator simultaneously

(ii) It is not advisable to use the hand brakes while the car is moving in forward movement.

IV. WORKING

In this work, Ratchet and Pawl mechanism is identified to arrest the backward motion to the car. The ratchet is placed in the front drive shaft and the Pawl is fitted with the frame. When the vehicle is moved in the hill road, the lever has to make the pawl to touch the ratchet. If the vehicle tends to move backward direction, the pawl would stop the ratchet to move Counter Clock-wise direction with respect to front wheel.

As the vehicle is in neutral position, the pawl engaged the ratchet and the vehicle did not move in

backward direction. So the hand brakes need not to be applied.

When the vehicle is in moving condition, the engagement between the ratchet and pawl is detached.

V. DESIGN OF RATCHET AND PAWL

The mechanism is designed for the loading conditions of MARUTI Swift DZIRE. The circumference of the front drive shaft of this car is measured and the diameter is determined as 23.89mm. The weight and Torque of the MARUTI SWIFT DZIRE car are 1060 Kg and 190N-m, respectively.

SLOPE OF THE ROAD**:** The steepest road in India is ZOJI PASS in KASHMIR and the angle of inclination of the road is found to be 21.80 degrees. The percentage slope there is about 40 %.

The material considered for ratchet and pawl are

Figure 2. Three dimensional model of Ratchet &

Pawl Mechanism.

Grey cast iron and C45 respectively. Both surfaced are considered to be hardened. The number of teeth on ratchet wheel is assumed as 12. The following parameters are considered for the design of the mechanism. The three dimensional model of the mechanism is shown in Figure 2.

Module	(m)	= 5mm
Width of ratchet	(b)	= 12.5 mm

The fabricated Ratchet and Pawl mechanism is shown in Figure3.

Figure 3: Fabricated Ratchet and Pawl Mechanism

VI.ANTI ROLL BACK MECHANISM

Figure 4: Anti Roll Back Mechanism

Diameter of pawl	(D_p) =	14.47mm
Length of pawl	(L) =	31.4mm

The fabricated mechanism is fitted in drive shaft for testing experimentally to check whether the functionality has been achieved (Figure 5). The hand driven lever is turned in forward direction,

similar to forward motion of the car, the pawl does not stop the ratchet to rotate. The hand lever is turned in opposite direction similar to the reverse motion of the car in the hill road, and the pawl stops the rotation of the ratchet. So, the drive shaft and the wheels did not rotate. Therefore the reverse motion of the wheels is arrested. The same can be achieved if this model is fitted in the car. This will be the case while fitting this mechanism in the drive shaft of the car. When it has been done the car cannot move in reverse direction in the slope as the pawl locks the ratchet.

VII. CONCLUSION

Thus the mechanism can stop the vehicle from rolling back in hill roads. This would be more helpful for the drivers to drive their cars comfortably in hilly roads and he can take off the car in the uphill without rolling back the car.

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BIOGRAPHIES

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