AUTOMATIC REVERSE WHEEL LOCKING MECHANISM

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Abstract: *Road transport safety is an important issue in the land transport sector all over the world due to the increment in the usage of automobiles in few decades. The paper presents "AUTOMATIC REVERSE WHEEL LOCKING MECHANISM" for both light and heavy vehicles. This paper outlines system requirements to successfully develop and deploy a less complicated, safe and secure mechanism for the uncontrolled reverse motion of the vehicle on hilly terrains. The mechanism consists of a vehicle and ratchet & pawl connected to the rear drive shaft of the vehicle and an actuator along with the help of an inclination sensor which will control the movement of the pawl while engaging or disengaging the mechanism. The engaging mechanism will represent the reverse motion is undesirable or to be restricted and disengaging mechanism when the reverse motion is desirable.*

***Key Words*: Ratchet, Pawl, Actuators, Inclinometer.**

1. INTRODUCTION

Ratchets and pawls are mechanical gearing assemblies that are used to transmit intermittent rotary motion, or to permit a shaft to rotate in one direction but not the other. They are used in many applications effectively which includes a Gaint Wheel in the amusement parks, Clocks, Shaping machines etc.

The current invention relates to the automatic locking of a vehicle against the rearward motion except when the vehicle is in the reverse gear. In general, automatically locking rear or drive wheels of a vehicle against reverse rotation so as to prevent accidents. In a recent analysis of fatal accident statistics showed that reversing activities were involved in 12% of all the fatal transport accidents. Accidents during reverse movement results less in injury but, more damage to vehicles and other human properties.

1.1 Objective

- The main objective of our project is to prevent these types of accidents and unexpected reverse movement with some simple and economical means.
- To prevent the uncontrolled reverse motion of an automobile under slopes and hilly roads.
- To protect drivers and pedestrians from disastrous accidents occurring due to Loss of control and improper handling of equipment.
- To ensure safety of the driver and vehicle on inclined terrains.
- To increase the life of brakes and to reduce the fuel consumption.

1.2 Problem Definition

- The most common problem in the hilly terrains is to park the vehicles in the slope and to start up.
- While waiting in traffic on mountain roads the vehicles had to move very slowly step by step, this situation is difficult for drivers to make the car not move back and may lead to accidents.
- This problem may occur due to driver's carelessness or improper handling of the vehicle equipments.
- The problem associated with the brakes is that it locks all the four wheels of the vehicle so that it will not be able to move in forward as well as in the reverse direction.
- So as to avoid such cases we designed a simple and economical equipment which will give a solution to the above mentioned problems.

2. COMPONENTS

There are basically four components which are used for the designing of the equipment, and they are:

a) Ratchet
b) Pawl
c) Actuator
d) Inclinometer(Inclination Sensor)

a) Ratchet

A ratchet is a mechanical component having circular profile with teeth on the circumference spirally arranged such that it allows motion in only one direction. Each tooth has slight slope that is broader at root and sharper at top.

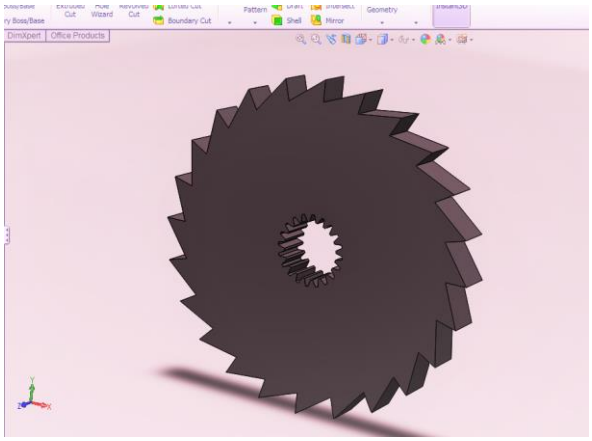

Fig -1: Ratchet

When the teeth are moving in the constraint (i.e., forward) direction, the pawl easily slides up and over the gently sloped edges of the teeth when the teeth move in the opposite (backward) direction, however the pawl will catch against the steeply sloped edge of the first tooth it encounters, thereby locking it against the tooth and preventing any further motion in that direction.

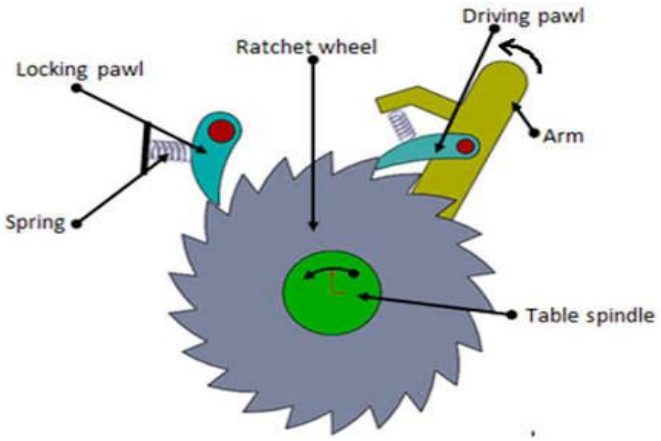

Fig -2: Locking of Ratchet and Pawl

Because the ratchet can only stop backward motion at tooth boundaries, thus does allow a limited amount of backward motion. This backward motion which is limited to a maximum distance equal to the spacing between the teeth is called backlash.

b) Pawl

A pawl is a pivoted curved bar with a notch at its free end. It gets engaged between the teeth of the ratchet wheel and prevents its motion in one direction.

The pawl strikes against the surface of ratchet teeth at an angle so that any backward motion will cause the pawl to jam against the surface and thus prevent any further backward motion.

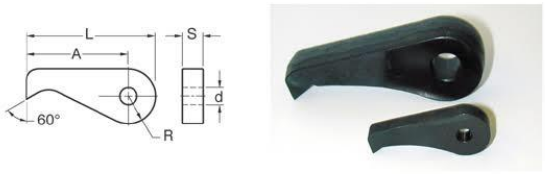

Fig -3: Pawl

Since the backward travel distance is primarily a function of the compressibility of the high friction surface, this mechanism can result in significantly reduced backlash.

c) Pnuematic Actuators

An actuator is a component of machine which is responsible of moving and controlling a mechanism of a system.

A pneumatic actuator converts the pressure energy of compressed air into mechanical motion. The motion can be rotary or linear. The main part of a pneumatic actuator consists of a piston which develops the driving force.

(a) **(b)**

Fig- 4: (a) Open section view of an actuator vessel (b)Poppet design actuator

A pressure transmitter will monitor the pressure in the vessel and transmit a signal from 20–100 KPa. 20 KPa means there is no pressure, 100 KPa means there is full range pressure. As the pressure rises in the vessel, the output of the transmitter rises, this increase in pressure is sent to the valve, which causes the piston to stroke downward and start closing the valve, and hence the motion is transmitted to the source.

d) Inclinometer

An inclinometer is an electro-mechanical device which measures angles and sends the output in the form of electrical signals. It is also known as tilt sensor. It makes an virtual horizon and measures angular deviation with respect to that horizon.

Fig- 5 Inclination sensor

They are used in cameras, aircraft flight controls, automobile security systems and in other applications requiring measurement of tilt.

Factors which influence the use of inclinometers

- Gravity
- Temperature (drift), zero offset, linearity, vibration, shock, cross-axis sensitivity, acceleration/deceleration.
- A clear line of sight between the user and the measured point is needed.
- A well defined object is required to obtain the maximum precision.
- The angle measurement precision and accuracy is limited to slightly better than one arcsec.

3. SELECTION OF MATERIAL

Material to be considered for ratchet and pawl are Grey Cast and C45. The reasons for selecting the material are as:

- Readily available
- Available in required standard sizes
- Economical to use
- High tensile strength
- Moderate factor of safety

The mechanism is designed for the loading conditions of an All Terrain Vehicle(ATV) weighing 250 Kg and 2 ratchets are attached on the rear drive shaft along with 2 pawls so as to make the unexpected reverse motion to be constraint. The assembly is mounted such that both the rear wheels would be equally balanced.

4. FABRICATION PROCESS

I. The ratchet wheels are been coupled with two of the rear drive shafts near the center hub.

II. The wheels are attached to the both the ends of the drive shaft form an axle like structure.

III. The steel bars are cut into equal lengths to design a frame which supports the pawl and the lever mechanism along with the rear wheels.

IV. The lever mechanism is to engage and disengage the pawl from ratchet wheel.

V. Here we used a pneumatic actuator controlled by an inclination sensor to actuate the lever.

5. WORKING

When the vehicle is stationary in an inclined surface, it is impossible to operate 3 foot pedals by 2 foot to start the vehicle from rest to forward motion with ease.

To solve this problem, we make use of a ratchet wheels which are attached to the drive shafts. The ratchet wheel is engaged with the help of pawl which is controlled by the help lever, inclination sensor and actuator.

The inclination sensor is mounted on the front axle or drive shaft which will be operated as there would be a deflection of 15˚ or more. So, as the vehicle comes across through a steeper road of gradient of more than 15° then the pawl will come in engage position with the ratchet and will constraint the reverse motion of the vehicle.

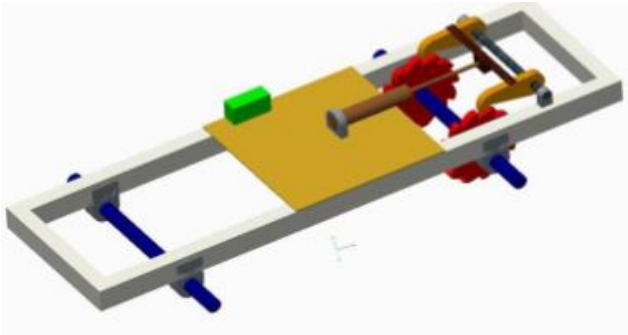

Fig-6: CAD model of the arrangement

So, the working of the arrangement can be clearly understood from the model. The drive shaft(shown in blue color) is been coupled with ratchet(shown in red color) and the pawl(shown in orange color) will be engaged or disengaged with help of pneumatic actuator(shown in green color).

The electric supply is given to the sensor along with the actuator by the help a battery installed in the vehicle. Due to this as the sensor senses the slope then the actuator comes in action. The sensor send's an electric energy in the form of an electrical signal to the pneumatic actuator. It converts the electrical energy into mechanical motion and the motion is linear. The output of the actuators is connected to the lever from the two Pawls.

When outlet shaft of the actuator moves inward, the pawl will rise i.e. disengagement will take place and the vehicle will be able to move in both the directions viz forward and reverse direction. Now as the outlet of the actuators will move outward the pawl will fall and engagement will take place. Now, the reverse motion of the vehicle will be constraint i.e. the vehicle will not move in the reverse direction it will only move in forward direction. In this way the engagement and disengagement of Ratchet and Pawl will take place.

6. CONCLUSION

Our project "Automatic Reverse Wheel Locking Mechanism" would help in avoiding the rearward motion of the vehicle on the hilly terrains and Ghats. Since a less complex structure is been used in our design, it can be easily used by new drivers. 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 and park them comfortably in hilly roads.

7. FUTURE SCOPES

The modifications to be done in this project are material strength and accuracy of working of the mechanism. And it could be achieved by designing and analyzing the mechanism according to the vehicle need and calculating the forces for safety measures.

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