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Hill Assist Control System

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Abstract

The purpose of the paper is to analysis and reviews the already developed anti-roll back mechanisms for vehicles and other mechanisms of the same kind, to find the shortcomings ofeach of them, which hindered its general use in the vehicles, and to propose a mechanism overcoming all those shortcomings. Anti-roll Back Mechanisms or Unidirectional Motion Mechanisms are the mechanisms which may be added to the conventional gear box of a vehicle, to provide the remedy for the issue of descending of the vehicle under the influence of self-weight, faced while starting a vehicle to move uphill.

Technically, this mechanism encounters the issue free motion of the shafts of thegearbox as

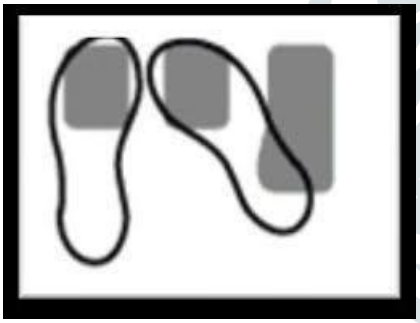


Fig 1.1- Schematic representation ofoperating the brake

the vehicle tries to roll downhill when the clutch is pressed (disengaged) for the moments in which driver shifts his foot from the brake pedal to accelerator pedal to accelerate the engine.

Such mechanisms restrict one or the other shaft(s) of the gearbox to rotate opposite under theinfluence of wheels, thereby restricting vehicle to roll back in opposite direction. In this workthe 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 arrestthe motion to the front axle. Anti-Roll Back mechanism has been fabricated and tested on thefront axle assembly. The mechanism works well.

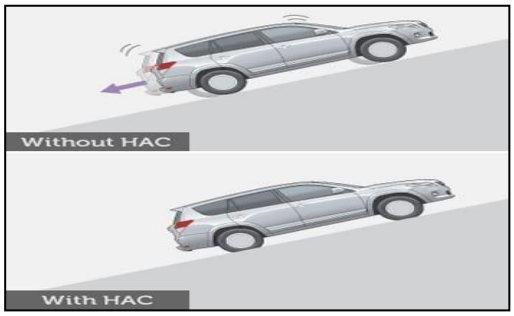
The mechanism is used in many applications effectively where the one side power transmission is required for example in (I) Giant wheel-It is the large wheel used in the amusement parks to rotate along the horizontal axis to rotate in one direction while carrying the number of passengers. (ii) Clock where the hands rotate in clockwise directions only. (iii) Baffle gates in the entrances of many buildings which rotate about vertical axis in one direction.

(iv) Shaping Machines in the crank and slotted arm. Inthe hill station, the most common problem to the drivers istopark 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 difficult one for the drivers to make their car not to roll back in the slope. So the mechanism haste 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 thatched 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 Marti Swift Dire car is considered and the ratchet and pawl has to be designed for it. In order to design for theworst case the road maximum slope is considered Zoji pass Road Kashmir which has 21.80 with gradient 2/5.

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 rotate about vertical axis in one direction. In the hill station, the most common problem to the drivers is to 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 tostop 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.

Effect of Hill assist Control on Vehicle



For conventional trucks in India, moving uphill is often a very risky proposition, particularly with a fullpayload. The vehicle risks rolling back if the driver lets go the clutch with not enough power on the gas. In high-end commercial vehicles though, technologies like the Electronic Braking Systems (EBS) helps pull away the vehicle from a standstill on steep gradients with no risk of rolling back. As a common practice in the country, the parking brake is usually engaged, when loading or unloading a vehicle or on inclines to avoid roll back. This is never a full-proof option, and requires adequate drivingskills to ensure operation. That was the challenge that the engineering team at KBI took up, that of developing a technically suitable and commercially viable system for the Indian market that predominantly runs on vehicles with manual transmissions. When the vehicle is stationary and inclined,the releasing of brakes activates the flow control means, which releases the air from the rear brake actuator at a slow rate. That enables the vehicle to remain stationary even after the brakes are released.
The slow release of air provides the time needed for the driver to feel and accelerate the vehicle, either to drive up the hill or reverse it. The present invention in a preferred embodiment provides systems andmethods for preventing a vehicle from reverse movement ona slope.

The system comprising of a) A heavy commercial vehicle. b) A ratchet and pawl device connected to atleast one wheel of the vehicle. C) A connecting or fastening component which connects the ratchet andpawl device such that the wheel shall rotate only if the ratchet and pawl device rotates. D)And electronic mechanism i.e. Actuator which will control the movement of the pawl while engaging or disengaging the mechanism Where in the system may be engaged using an engaging mechanism when reverse motion is undesirable or to be restricted, and may be disengaged when the reverse motion is desirable.

Keywords:
Anti-roll back mechanism, unidirectional motion mechanisms, Ratchet and Pawl mechanism, etc.

Problem Statement:
In the hill station, the most common problem to the drivers is to 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 situationis a difficult one for the drivers to make their car not to roll back in the slope. So, the mechanism has tobe developed to stop the vehicle from rolling back and it should not stop the vehicle in accelerating forwards.

Objectives:
To overcome problem of sliding in reverse direction of a vehicle while on hill or any inclinedsurface.

To replace the electrical component in design of hill assist braking system by ratchet & pawlfor cost consideration

Methodology:
In this work, Ratchet and Pawl mechanism is identified to arrest the backward motion to the car. The ratchet is placed in the rear drive shaft and the Pawl is fitted with the frame. When the vehicle is movedin 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 respectto front wheel. As the vehicle is in neutral position, the pawl engaged the ratchet and the vehicle did notmove 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. By activation of lever to stop power when ever needed.

Literature review

Arunkumar, T. Muthumani et.al has Studied 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. 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 [1].

Mohamed Krid, Faiz Benamar et.al has studied integrated approach of an active anti- roll system has been presented. An innovative kinematics which can be easily added on existent off-road chassis is proposed. A model predictive controller based on minimization of load transfer and energy consumption is designed. Simulation results show that this system improves the performance and the stability of the robot when cornering. An important advantage of the proposed solution is its easy integration as new part, without any transformation of the original chassis. This system can be controlled independently and is demonstrated to have no effect on the dynamics of path controller. A new rover based on an existent commercial chassis is currently under construction to equip it with electric actuators,sensors, and the active anti- roll system detailed in this paper. The next steps will focus on theexperimental validation of this promising new system. Another challenge for increasing offroad performance, would be the design and development of innovative systems for preventing tipover instability along both roll and

pitch axes. [2].

J. A. Kennedy & L. L. Howell et.al has studied a ratchet and pawl ring mechanism that has advantages for mechanical safety mechanisms, particularly when the design envelops is too small to allow for traditional mechanical components. The mechanism constraints are outlined and the mechanism and its modeling are defined. A series of three scaled prototypes and their testing are described [3]. William K. Messer smith & Keith H. Fulmer et.al has studied booster connected to a control circuit provides a system for the continued braking of avehicle when the vehicle is situated on an incline and the brake pedal is released by the operator. Continued brake application is accomplished by utilizing a control circuit responsiveto vehicular attitude, clutch pedal position, and vehicular direction. The control circuit is connected to the combination of a check valve and two-way solenoid valve connected to movable wall brake booster. The combination valve is connected to a flexible hose disposed interiorly of the booster, and the other end of the flexible hose connected to the input openingof a three-way poppet valve located at the central hub of the booster. When the control circuitsenses that the vehicle is on an incline, the clutch pedal depressed, the ignition "on", and the vehicle not backing up, it actuates the two-way solenoid of valve which continues to supply a first fluid pressure to the front booster chamber while closing to prevent the supply of the first fluid pressure to the rear booster chamber, via the flexible hose and poppet valve [4].

Cook George et.al invented relates to an anti-creep and hill holder brake system andmore particularly to a brake system which prevents the creeping or rolling of automobiles equipped with either automatic fluid transmissions or friction clutches. Presently known typesof anti- creep or antiroll systems incorporate a circuit having a number of switches with one switch being operated by the ignition key, another by the accelerator pedal and another by the movement of the vehicle. Because of the slow actuation provided for these switches, present systems do not operate satisfactorily since the systems do not respond properly to the actions of the driver and interfere with the actions of the driver.

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 anda 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 pluralities of engaging teeth of the outer race as the outer race rotates in the secondrotary direction.

mechanism in the drive shaft of the car. When it has been donethe car cannot move in reverse direction in the slope as the pawl locks the ratchet

Driving device

D.C Motor :

Anti Roll Back Mechanism

Principle

The power drive shaft is connected to locking mechanism which drives the rear wheel connection . whenever the shaft is rotated in forward direction the locking is open by control 10witch. As when everon the stop road climbing the vehicle try roll in down ward direction . that isreverse direction in this circumstance the cylinder locks the geart resulting the motion to stop in reverse direction ,hence the rollof the vehicle is comes to rest . the entire load is locked on the lock lever which should have capacity tohold. As soon as the power from drive shaft is delivered to the vehicle the ratchet starts to move in forward direction resulting releasing of lever . the released pawl will allow the vehicle to move in forward direction.

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 Clockwise direction with respect to front wheel. As the vehicle is in neutral position, the pawl engaged the ratchet and the vehicle did notmove 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 with the help of mechanical lever.

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 rotationof the ratchet.So, the driveshaft and the wheels did not rotate. Therefore the reverse motion of the wheels is arrested. The same can be achieved if this model is fittedin the car.

This will be the case while fitting this

DESCRIPTION OF DC MOTOR

An electric motor is a machine which converts electrical energy to mechanical energy. Its action isbased on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left handrule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DCmotors are also like generators classified into shunt wound or series wound or compound wound motors.

Fleming's Left Hand Rule:

Keep the force finger, middle finger and thumb of the left hand mutually perpendicular to one another.If the fore finger indicates the direction of magnetic field and middle finger indicates direction of current in the conductor, then the thumb indicates the direction of the motion of conductor.

Principle Of Operation of DC Motor:

Figure I show a uniform magnetic field in which a straight conductor carrying no current is placed. Theconductor is perpendicular to the direction of the magnetic field.

In figure II the conductor is shown as carrying a current away from the viewer, but the field due to theN and S poles has been removed.

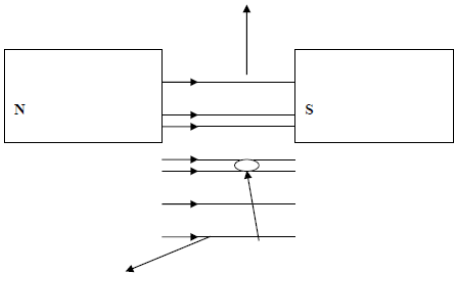
There is no movement of the conductor during the above two conditions. In figure III the current carrying conductor is placed in the magnetic field. The field due tothe current in the conductor supports the main field above the conductor, but opposes the main field below the conductor.

The result is to increase the flux density in to the region directly above the conductor and to reduce theflux density in the region directly below the conductor. It is found that a force acts on the conductor, trying to push the conductor downwards as shown by the arrow. If the current in the conductor is reversed, the strengthening of flux lines occurs below the conductor, and the conductor will be pushed upwards

Now consider a single turn coil carrying a current as shown in figure V. in view of the reasons givenabove, the coil side A will be forced to move downwards, whereas the coil side B will be forced to move upwards. The forces acting on the coil sides A and B will be of same magnitude.

direction is opposite to one another. As the coil is wound on the armature core which is supported bythe bearings, the armature will now rotate. The commutator periodically reverses the direction of current flow through the armature. Therefore the armature will havea continuous rotation.

A simplified model of such a motor is shown in figure VI. The conductors are wound over a soft iron core. DC supply is given to the field poles for producing flux. The conductors are connected to the DCsupply through brushes.



Battery:

In isolated systems, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the
only technically and economically available storage means. Since both the photo-voltaic system andbatteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

(1) Low cost

(2) Long life

(3) High reliability

(4) High overall efficiency

(5) Low discharge

(6) Minimum maintenance (A) Ampere hour efficiency

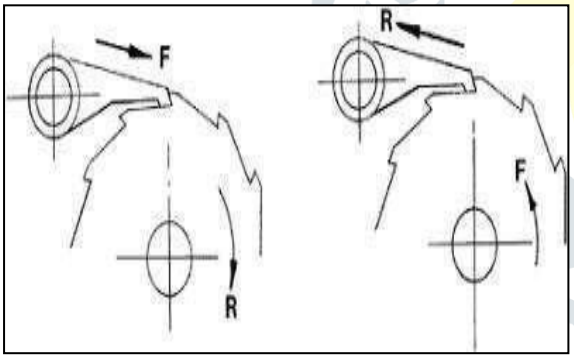
(B) Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel forlighting the street .

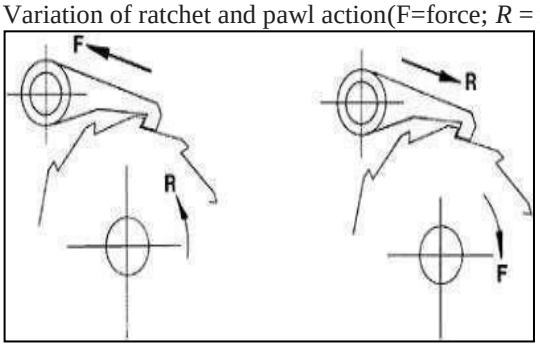
Ratchets And Ratchets Gearing

A *ratchet* is a form of gear in which the teeth are cut for one-way operation or to transmit intermittent motion. The ratchet wheel is used widely in machinery and many mechanisms. Ratchet-wheel teeth canbe either on the perimeter of a disk or on the inner edge of a ring.
The *pawl*, which engages the ratchet teeth, is a beam member pivoted at one end, the other endbeingshaped to fit the ratchet tooth flank.

Ratchet Gear Design. In the design of ratchet gearing, the teeth must be designed so that the pawl willremain in engagement under ratchet- wheel loading. In ratchet gear systems, the pawl will either push the ratchet wheel or the ratchet wheel will push on the pawl and/or the pawl will pull the ratchet wheelor the ratchet wheel will pull on the pawl. See Figs. 8.1a and b for the four variations ofratchet and pawl action. In the figure, *F* indicates the origin and direction of the force and *R* indicatesthe reaction direction.



Variation of ratchet and pawl action(F=force; *R* = reaction).

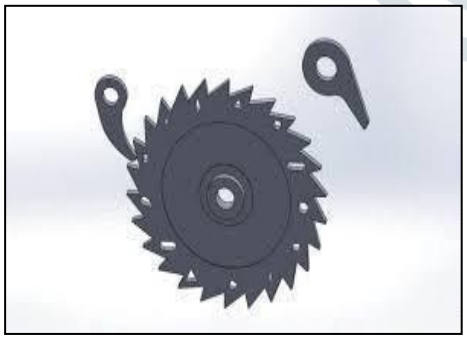


Variation of ratchet and pawl action(*F* = force; *R* = reaction)

Gear Mechanism

Mechanism Description

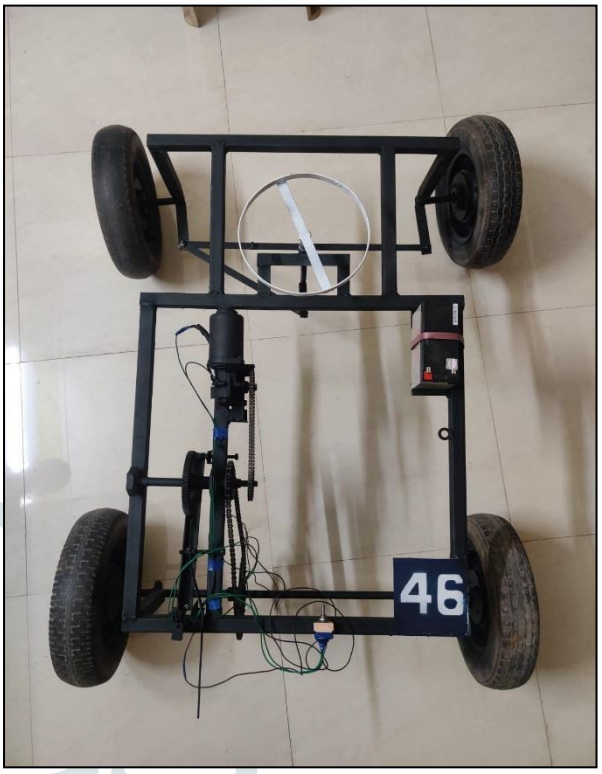
The RaPR mechanism described in this work was designed with the following design criteria as constraints: the ratchet wheel should advance one and only one tooth per actuation pulse; the ratchet wheel driver and restraint mechanism will be in a planar arrangement; the ratchet mechanism should operate on as little space of the ratchet wheel as possible; stand-alone spring elements and complicated assemblies should be minimized or eliminated; moving parts should be balanced about their pivot points; the aspect ratio of parts will be 10:1 or less; the device must be able to be actuated by a stator electromagnet; the driver mechanism will act as the rotor to the electromagnet stator by completing a magnetic circuit; the ratchet wheel will have 36 teeth; no lubricants will be



considered for friction reduction; the ratchet mechanism will be designed such that it can be fabricated using micro wire Edm.

Schematic Diagram

Actual Model



Design Of Ratchet And Pawl

The mechanism is designed for the loading conditions of MARUTI Swift DZIRE. The circumference ofthe front drive shaft of this cares measured and the diameter is determined as 23.89mm.The weight and Torque of the MARUTISWIFTDZIRE carrare1060Kgand190- m, respectively. SLOPE OF THE ROADThe steepest road. in India shoji 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 %.

Three dimensional model of Ratchet & Pawl Mechanism

Recast iron and C45 respectively. Both surfaced are considered to be hardened. The number of teeth onratchet wheel is assumed as 12. The following parameters are considered for the design of the mechanism. The three dimensional model of the mechanism is shownin Figure 2 .Module (m)=5mm

Width of ratchet (b) =12.5 mm Diameter

of pawl (Dip) =14.47mm Length of pawl

(L) =31.4mm

The fabricated Ratchet and Pawl mechanism

Design Of Ball Bearing

Bearing No. 6202

Outer Diameter of Bearing(D) = 35 mm

Thickness of Bearing (B)= 12 mm

Inner Diameter of the Bearing (d)= 15 mm r_1 = Corner radii on shaft and housing

r_1 = 1 (From design data book)

Maximum Speed = 14,000 rpm (From design databook)

Mean Diameter (dm) = (D + d) / 2= (35 + 15) / 2dm = 25 mm

Spring index (C) =(D /d)= 35 /15 C = 2.3

Wahl Stress Factor

Ks = 4C – 1+0.65 4C–4C
= (4 X 2.3) -1 + 0.65(4 X 2.3)-42.3

Ks = 1.85

Design for motor selection This value is assumed that , Total mass=15 kg (app.)

Assume that μ is neglected due to motion of plates w = m*gw.81 w =15*9= 147.15N
w = RnF =
μ*RnF =
μ*w F =
147.15 N
T = F*r

Since, r = radius of drive sprocket R=2.5cm,
T= 147.15 *2.5= 367.875 N-cm T = 3.67 N-m

T = 37.5 Kg-cm

As we have to walk robot on horizontal surface, we require initially more torque & less speed. All these requirements can be fulfill by D. C. Geared motor.

As per the graphs, current is directly proportional to torque & inversely proportional to speed. Hence forour robot we have selected

Design Of Small Gear Pawl

From PSG design data book (page no.7.18)

dmin > (0.59/ σcmax) x [[Mt]/((1/E1)+(1/E2))
2](1/3_____(1)

Where,

σcmax = maximum contact compressivestress N/m^2

E1, E2 = Young's modulus N/m^2Mt = Torque N-m

E1 = E2 =1.1x106 N/m^2 Calculation ofσc_{max}

σcmax = HB x CB x Kcl_____(2)Where,

HB = Brinell hardness number CB =coefficient depends on hardness

Kcl = life factor

Kcl = {[1 x 107]/N} 1/6_____(3)

N = 60 x n x TWhere,

n = rpm N = life in no. Of cyclesT = life in hours. = 8000 hours.

From P.S.G design data book (pageno.2.4),

CB = 20 HB = 200

Substituting the values of N, n, T in theequation [3],

The value of kcl is obtained as 1.139.Kcl = 1.139.

Substituting the values in equation [2] σcmax = 20 x 200 x 1.1309 = 4520 x105
N/m^2

Calculation of Mt Mt = 97420 x (Kw/n).
_____(4)

For power calculation Centrifugal force,fc = m ω2 r
_____(5)

M = 7kg W = m x g = 2Πn/60 R = 1m

Substituting the values of m, ω, r inequation [4]

fc = 7.56 N.

Downward force,

fd = m x g = 7 x 9.81 = 68.6N.

Centrifugal force,

f = fc + fd = 68.6 + 7.56 = 76.17N

Torque = f x r = 76.17 x 1 = 76.2Nm.Power = Torque x angular velocity.

= 76.2 x 1.05 = 79.7w
Substituting the values of σcmax, [Mt], E1,E2 in equation [1],

The minimum diameter of the pinion is calculated to be 78.7mm.

We have taken the standard diameter of pinion as 75mm.

Specification Of (Pinion) rachet 3.3.1

Specification Of GEAR Material : cast-iron

Outside diameter : 75mmCircular pitch :

4.7mm Tooth depth : 3.375mm Module :

1.5mm Pressure angle : 21

Pitch circle diameter : 72mmAddendum :

1.5mm Dedendum : 1.875mm

Circular tooth

Thickness : 2.355mm

Fillet radius : 0.45mm

Clearance : 0.375mm

Design of Driven gear

Pitch circle diameter of the gear is =72mm

Circumference of the gear is = π x pitchcircle diameter = π x72 = 226mm

The dimension is for 360 rotation

For 180 rotation the rack length is 113mm

List of Materials:

SR NO.	PARTS	QTY
1	Gear Arrangement	1
2	Ratchet Gear	1
3	Control Lever	1
4	Wheels	4
5	Shaft Drive	1
6	Bush	1
7	Chain Set	4
8	Connecting Rod	5
9	Bearing And BearingHousing	6
10	Frame	1

Total Cost

Total cost = Material Cost + Labour cost

=9570 + 2500

=12070

Total cost for this project = **12070**

Expected outcome / Future Scope:

While implementing this new technique in every vehicle can determine the new opening to reduce losses and casualties. The anti roll system help to reduce the breaking and acceleration control difficulties of the vehicle driver are tremendously reduced by this automation while climbing on the stiffhigh height surface. The roll of we be directly avoided by the self holding mechanism. If any failures or fault will not be affect the reverse rolling of vehicles. The safety factor for any vehicle while moving on the hill or any other surface

Advantages:

It requires simple maintenance caresThe safety system for automobile.

Checking and cleaning are easy, because of the mainparts are screwed.

Easy to Handle.

No Manual power required is lessRepairing is easy.

Replacement of parts is easy.No Oil wastage.

Disadvantages:

Initial cost is high. High maintenance cost

Application:

It is very much useful for Car Owners & heavy trucks.

This lock braking system is used for smooth anti roll ofvehicle of the vehicles.

Thus it can be useful for the following types ofvehicles;

1) MARUTI, 2) AMBASSADOR, 3) FIAT, 4)MAHINDRA, 5)TATA

Conclusion:

This project work has provided us an excellent opportunity and experience, to use our limitedknowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completedthe work with the limited time successfully.
The ANTILOCK HILL HOLD ROLL BACK
LOCKING SYSTEM is working with satisfactory conditions. Weare able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more linesabout our impression project work.

Thus, we have developed an "ANTI LOCK HILL HOLD ROLL BACK LOCKING
SYSTEM" which helps to know how to achieve low cost automation and ANTI LOCK application. Theapplication of pneumatics produces smooth operation. By using more techniques, they can be modified and developed according to the applications.

Referances:

1. G.B.S. Narang, "Automobile Engineering",Khanna Publishers, Delhi, 1991, pp 671.
2. William H. Crowse, "AutomobileEngineering".
3. Donald. L. Anglin, "AutomobileEngineering".
4. Pneumatic Control System------- Stroll & Bernaud, Tata Mc Graw Hill Publications,1999.
5. Pneumatic System------- Majumdhar, New Age India International (P) Ltd Publishers,1997.