7th National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(1st and 2nd March 2019)
International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

Modification and Fabrication of Open Differential for Anti-Slip Effect

Aalap Save[1], Swaraj Sawant[2], Anay Satelkar[3], Nilesh Nagare[4]

Department of Mechanical Engineering, VIVA Institute of Technology, VIRAR (E)

Abstract*—India is a developing country and hence the vehicle market in India is cost driven. Most of the everyday cars use open differential. But it has some shortcomings. To overcome this, various types of limited slip differential are used, but they are too expensive to be accommodated in a low cost vehicle. This project aims to modify an open differential of a goods carrier like TATA ACE to act like a limited slip differential. The open differential will be modified by using a centrifugal clutch. The spring of the centrifugal clutch will be designed. This method will be economical as minimum changes are made to the original differential. This method can be of great help to small sized pick up vehicles. The clutch can also be controlled using a solenoid valve so as to engage only when needed.*

Keywords – Centrifugal clutch, Gear, Limited slip differential, Open differential, Wheels.

I. INTRODUCTION

The inner and Outer wheels of a vehicle in a turn actually carve two different circles of different radii, they travel a different distant on the same turn. Since the wheels are usually the same size the outer wheel has to rotate faster to keep up with the inner Wheel which is travelling a shorter distance in the same time. When you connect the wheels with a hard axle, like on a toy car the wheel is obliged to drag along uselessly while the other wheel controls the process. Now think of the rear wheel of a front wheel drive car. They are not in too much trouble because the engine isn't directly driving them. You could just uncouple them from each other and let them very their speed till they are happy. But when you add an engine into the mix, like on the front end on a front wheel drive car, things get complicated. As the engine now, is trying to turn the wheels at equal speed. But turning required the speed to vary and on a rigid axle they cannot. The result is a vehicle that's unwieldy to turn and use. Not nice. And that is where differential come in.

What they do is allow the two wheels to rotate at different speeds. It's a simple function but an important one and the mechanism is slightly complex. But in all cases a differential is placed between two driven wheels to allow the wheels in question to vary the rotational speed during a turn. In a front wheel drive car the differential or diff is seated within the same housing as the gearbox while a rear wheel drive car will feature the diff as a mid-axle globe into which the drive shaft disappears

The main difference between open differential and a Limited slip differential is noticed when the vehicle gets stuck. Open differential applies equal torque on both wheels and the maximum amount of torque is limited to greatest amount that will not make the wheels slip. It does not take much torque to make a tire slip. And when the wheel with good traction is only getting a very small amount of torque that can be applied to the wheel with less friction, the vehicle is going to get stuck. This is when Limited slip differential comes into play. It transfers the torque of one wheel to the other wheel which will be on traction surface. This helps the vehicle to overcome the problem.

II. METHODOLOGY

The process of making the project to achieve the aim included following steps

2.1 Initial Research

Initial research was conducted to find about the existing dilemma of the people due to two wheel drive, already available products and their cost and reach to people etc. Also data required for the design as well as manufacturing stage was collected. This includes the existing open differential of the vehicle, best position to accommodate the centrifugal clutch and the load carrying capacity of the clutch for the model etc. from modification aspects. For manufacturing material, availability ratings of motors, manufacturing resources etc. were found out.

International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

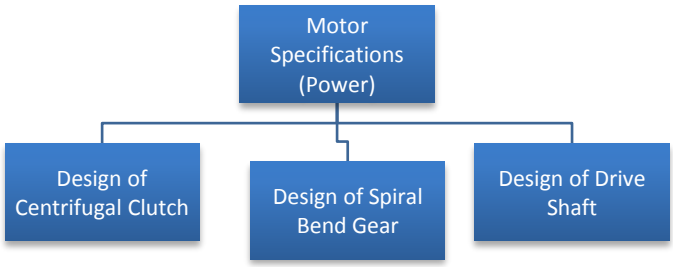

Fig.1 Design Methodology

2.2 Selection of Mechanism

Different mechanisms were studied and analyzed to find out the most economical method for converting the open differential into a limited slip differential. Finally a centrifugal clutch was selected to fulfill the need.

A centrifugal clutch is a type of clutch that uses centrifugal force to connect the two concentric shafts with the driving shaft nested inside the driven shaft. It engages more at higher speeds. The engagement of centrifugal clutch at the designed rpm will enable the transfer of torque from one wheel to the other.

2.3 Construction and Working

The model of open differential will first undergo weight reduction after removal of wheels and part of casing.The required rotary movement of differential shaft will be initiated by a 0.5 HP DC motor operated by a battery.Pulleys will be used to connect the motor and the drive shaft of the differential.Bearings will be used on both side of shaft.The open differential will first undergo weight reduction after removal of wheels and part of casing.The centrifugal clutch will be placed beside the ring gear as it can easily fit there without affecting the operation of differential.The required rotary movement of differential shaft will be initiated by a 0.5 HP DC motor operated by a battery.Pulleys will be used to connect the motor and the drive shaft of the differential.When automobile is stuck in a pothole, the wheel on the slippery surface rotates with high rpm compared to other wheel. When this happens the centrifugal clutch engages and transmits torque to the other wheel.

2.4 Final Design

Based on the calculations and rough design a solid model was done on Solidworks software with scaling 1:1 to get actual dimensional drawings of various parts, Few changes were made to Design as some assembly issues became known during modeling. The design was confirmed and a Solid model was built for visualization and manufacturing reference.

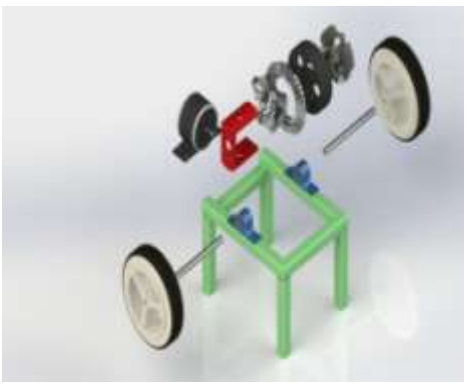

Fig.2 Solid Model of the AssemblyFig.3 Exploded View

International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

III. CONCLUSION

It is possible to convert an open differential into a Limited Slip Differential. The actual operation of differential will not be hindered due to it. Slipping of wheel can be reduced to a great extent by using modified differential. The total maintenance will also be low as the clutch does not have a continuous application. This method is also economical.

REFERENCES

[1] Yogesh Kumar Dewangan , Bhaskara K . Ch , Lokaditya Ryali, 2018, "LIMITED SLIP DIFFERENTIAL WITH SPRING MASS ACTUATOR FOR VEHICLE POWERED TRAINS", GM GLOBAL TECHNOLOGY OPERATIONS LLC.
[2] Utkarsh A. Patil, Vishal J. Savant, Rohit S. Bharamgonda, Prof. P. N. Gore, 2018, "RECENT ADVANCES IN DIFFERENTIAL DRIVE SYSTEMS FOR AUTOMOBILE PROPULSION", International Research Journal of Engineering and Technology (IRJET), pp3244-3249, Vol 05.
[3] Thomas L. Nahrwold , Randy L . Sommer, 2018, "DIFFERENTIAL CLUTCH CARRIER LUBRICATION AND COOLING SYSTEM", Dana Automative Systems Group, LLC.
[4] Crwaig S. Jacobs, 2009, "METHODS FOR CONTROLLING CENTRIFUGAL CLUTCH ENGAGEMENT USING ENGINE TORQUE REQUESTS", Eaton Corporation.
[5] Yasuhiko Ishikawa, 2004, "DIFFERENTIAL AND DIFFERENTIAL SYSTEM", Tochigi Fuji Sangyo Kabushiki Kaisha.
[6] Masao Teraoka; Satoshi Aiba; Kenji Hiraishi; Shuhei Ono, 1995, "DIFFERENTIAL APPARATUS WITH SPEED AND TORQUE SENSITIVE DIFFERENTIAL LIMITING FORCES", Tochigi Fuji Sangyo Kabushiki Kaisha.
[7] Kaoru Sawase,1995, " LEFT/RIGHT DRIVE TORQUE ADJUSTING APPARATUS FOR VEHICLE AND LEFT/RIGHT DRIVE TORQUE ADJUSTING METHOD FOR VEHICLE", Mitsubishi Jidosha Kogyo Kabushiki Kaisha.
[8] Toshio Kobayashi, 1992, "RESTTRICTING DEVICE FOR A DIFFERENTIAL IN A MOTOR VEHICLE", Fuji Jukogyo Kabushiki Kaisha.
[9] Daniel W. Roper, Rochester, Mich. 1984, "LIMITED SLIP DIFFERENIAL", Rockwell International Corporation.
[1] William C. Ottemann,1969, " CENTRIFUGAL ACTUATOR FOR LIMITED SLIP DIFFERENTIAL", Eaton Yale & Towne Inc