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# Study on Classification of Differential System in Automobile

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**Abstract** - This paper is introducing only classification of differential system. This paper is show on open differential system, locked differential system, limited slip differential system, electronic traction control. A differential system introduced here can be engaged or disengaged either manually or automatically, if difference in the speed of driven and rolling wheels to encounter then the differential is controlled to lock.

**Keywords** - Differential, ETC, LSD, Traction, Differential system.

## I. INTRODUCTION

A problem with an automotive differential is that if one wheel is held stationary, the counterpart wheel turns at twice its normal speed as can be seen by examine the complete scheme of automobile differential. This can be problem when one wheel does not have enough traction, such as when it is in snow or mud. The wheel without traction will spin without providing traction and the opposite wheel will stay still so that the car does not move. This is the reason for a device known as a "limited slip differential" or "traction control". It is a widely used on different vehicle. A steel space frame was chosen for the design since it is the most effective and cost efficient structure and commonly used for single sweater car are really always comfortable fill maneuverings or vehicle throwing a bad path. Most mechanical systems are accencial to modern development process. Most of real world engineering problem characteristics are cautious variable. A differential is required to sulfide a set of in equality and quality constant. If vehicles were not equipped with these dangerous devices, one of the wheels skid, causing premature and uneven wear of tires and other mechanisms of transmission, management and makes it difficult to bend and maneuver.[1]

## II. OPEN DIFFERENTIAL SYSTEM

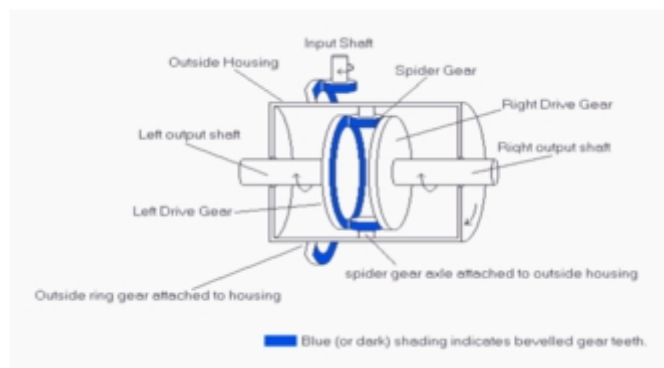


Fig. 1 Open differential for a rear wheel drive [1]

Open differentials (show the fig. 1) make use of a planetary gear set mechanism which distributes torque same between the drive axles while allowing the wheels to move at different rates. The input shaft transmits torque from the drive line to a large ring gear outside the differential. When the vehicle is travelling in a single path line the mechanism remains disengaged and the differential casing rotates at same rate as the drive axles. As the vehicle enters the turn the gear set

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engages and the meshing of the pinion gears allow the drive axle to rotate at different speeds [2] a front wheel drive car basically doesn't have a normal "Input Shaft", but everything else is the same. It prove greatly as there may be more than two spider gears and I didn't show the bearings where the output shafts go through the housing. A real differential is also very compact with all the gears nearly the same size and packed together. Additionally, all perpendicular gear intersections use bevel gears but that was too hard to draw. When the input shaft turn and the ring gear turns and then tire differential housing turns. But I'm getting ahead of myself. Let's see what the differential does all by itself from fig.1 both side left and right gear have teeth. They are directly attached to the end of the both side. Outer shafts easily turn on bearing it's called outside housing. A ring gear attached directly to the housing which takes power from the input shaft which comes from the engine. When input shaft is turn and ring gear is turn and in all differential housing turn. [1]

### III. LOCKED DIFFERENTIAL SYSTEM

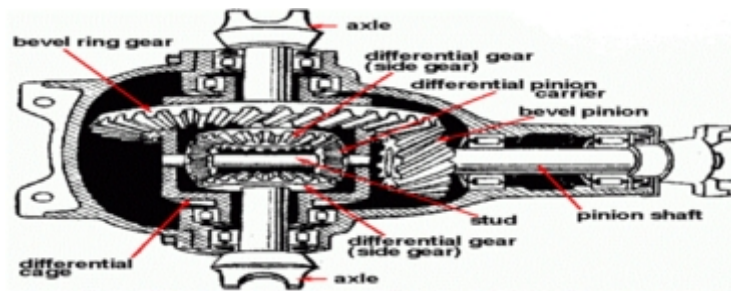


Fig. 2 Locked differential system [3]

During ordinary conditions, when the vehicle is drive straight road, and if the difference between speeds of the two rear wheels (shown in fig.2) which is minimum to the specified limit no signal will be generated by the electronic circuit. [6] But if the difference between speeds is maximum to the specified limit, then the signal will be generated by the electronic circuit. This causes gradual braking on the faster wheel until it gains traction. Hence, the wheels will never lose traction. This system ensures a reduction of more than 50% in the capital investment as compared to the already existing systems can tilt the scales in the favor of the manufacturing company and eventually the cost conscious consumer. [5] If u really comfortable feel in your vehicle on muddy patch. In dry conditions, when there is plenty of traction, the amount of torque applied to the wheels is limited by the engine and gearing; in a low traction situation, such as when driving on ice, the amount of torque is limited to the greatest amount that will not cause a wheel to slip under those conditions. So, even though a car may be able to produce more torque, there needs to be enough traction to transmit that torque to the ground .As long as the tire grips the road, providing a resistance to turning, the drive train forces the vehicle forward.[3]

### IV. LIMITED SLIP DEFFERENTIAL

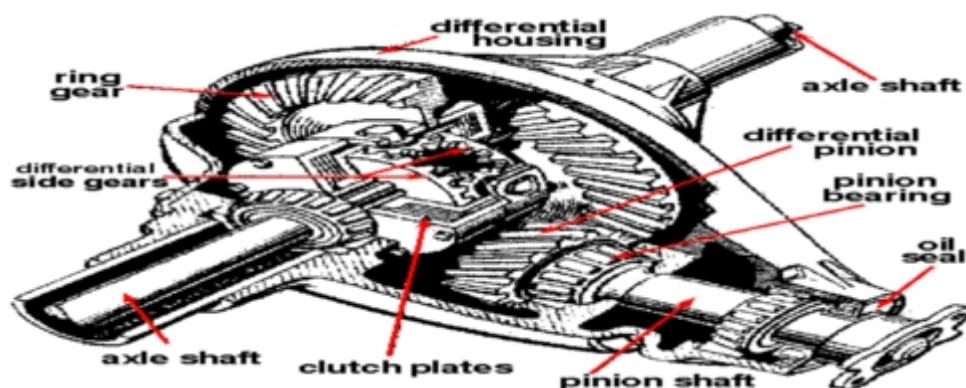


Fig.3 limited slip differential system [3]



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A limited slip differential is a compromise. We'd like a full locking differential in specific instances of extreme traction imbalance but otherwise would prefer operation closer to an open differential, so that the tires can turn at different speeds around corners.[1] Limited slip differential (LSD) have function as open differential one wheel exceeds what is normal in every day driving. When clutch is geared mechanism transfer torque from spinning to the one that is not. The main advantage of this system is street ability and smoothes operation. the LSD is completely invisible in its operation. LSD are a popular option for the front axle (shown in fig.3) where smooth operation and the ability to turn are more important, or any 4\*4 that will not see extreme use.[3]. There are following two types:-

- *Clutch Plate Limited Slip Differentials*
- *Viscous Limited Slip Differential*

### 1) *Clutch Plate Limited Slip Differentials*

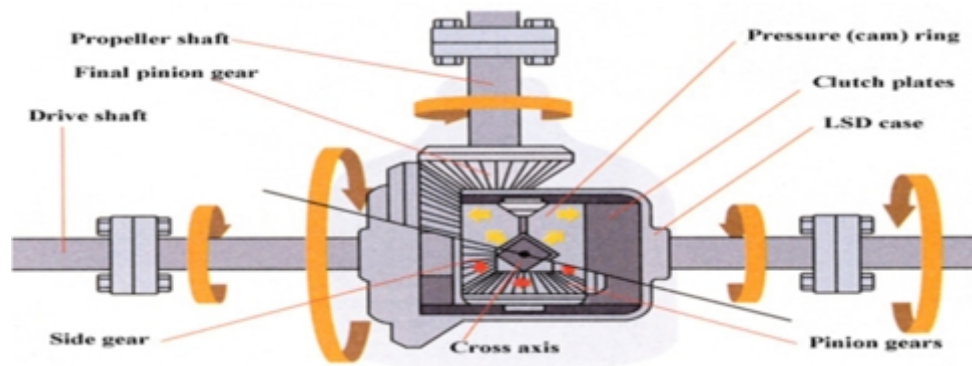


Fig. 4 clutch plate limited slip

The solution to the problem of useless torque distribution between axle are clutch plate differential. This function by making difference in speed of the inner & outer wheels during turn to improve the traction. Half of plate are mixed profile of the case while to the other half is mixed with each drive axle which is show in above figure [3]. On straight road driving the carrier and the axles turn with same rate. At beginning turn, the outer wheel going to spin faster than the inner wheels. [6] The obtain result is the engagement of the differential and initially the drive shaft torque is more equally distributed between the two axles. The differentiation causes the friction plates to turn in opposite directions and developed restraining force on the mechanism to keep each of the axles spinning at the same rate. [2] On the passive clutch differential system when one side loses traction and the tries to spin that side, the clutch simply show fixed amount of torque return to the other side. With a passive clutch, it does not get better with speeds. If anywhere it transfers minimum torque on the higher differential speeds, In some of same plate locking differential under minimum traction condition when drive going to corner at a normal speed then one side will spin and the other side drag.[1]

As a result, more torque is gradually transmitted to the outside wheel as its vertical load increases. The speed and torque characteristics are as below.

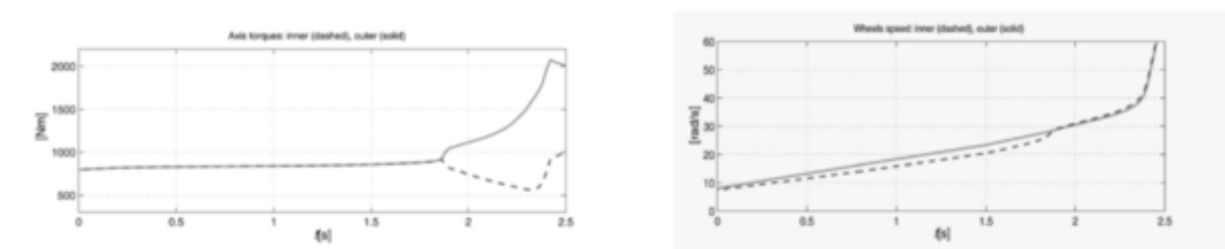


Fig.5 speed and torque characteristics on both side wheels [5]

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## 2) Viscous Limited Slip Differential

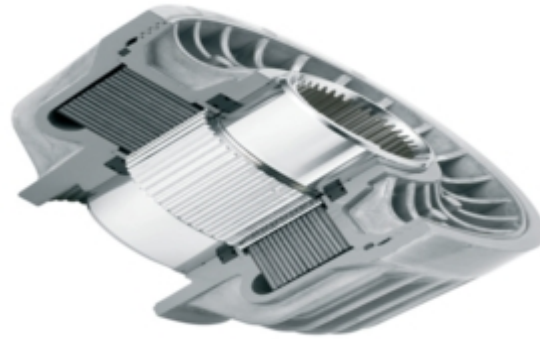


Fig. 6 Viscous limited slip [4]

Similar in many type of clutch plate design, this mechanisms employ viscous couplings are join to an open differential.[2] In driveline company's reliable speed-sensing Viscous Coupling and Viscous LSD are proven in front and rear axle applications as well as in on-demand and full-time all-wheel-drive drivelines. Viscous coupling and Viscous LSD are cost effective and highly durable speed-sensing limited slip designs. [4] A set of frictional surfaces is surrounded by one of several viscous fluids which are solidifying at high temperature. As the two axles (shown in fig.6) begin to round at different rate, the friction surfaces rotated in the fluid performing work and generate heat. Engagement is slightly stop as the fluid can't heat up suddenly. If the situation becomes so extreme that one wheel has almost no traction at all, the resistance provided by the fluid may not be applied quickly enough. The sometime coming work of this differential is that work generated in the fluid can over a critical limit. [2]

## V. ELECTRONIC TRACTION CONTROL (ETC)

It is really designed for emergency low traction situation and not drag racing or other long duration, low traction situations. This system is used by the VW GTI-VR6 and Mercedes ML320 and others car company. Start with an open differential. You're holding onto the right output shaft while the input shaft turns. Now add a disc brake and rotor on the left input shaft. When the computer senses a speed imbalance between left and right, it simply applies the brakes to the left side output shaft. The open differential immediately tries to balance the torque. You will feel it trying to turn the right side immediately. The ETC doesn't actually stop anything. So if one side is spinning and the other side has traction, then the ETC will slow the spinning side, and the torque transfers to the side with greater traction and either that side spins or the car moves.[1]

## VI. CONCLUSIONS

In this study many types of differential in automobile. It's working and how to turn, starts, spin on freely motion to create on the differential system. Differential amplifier for capacitor coupling of the tuning fork, by differential detection can effectively remove the noise affect. Thus, to obtain optimal performance for the classification problem, time-consumed grid search is always necessary. Nature inspired algorithms have been implemented successfully. They are very efficient and can be used to find out the global optimum solution with high probability.

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