Automatic Reverse Locking System Using Differential Unit

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***Abstract*- The proposed mechanism is to lock the differential. By locking the differential the differential is disengaged from the axle. Thus the power is directly transmitted to the axle and hence to the wheels. This will considerably reduce the power loss in some occasions when unwanted loss is happening due to the transmission if power from the shaft to the differential and then to the axle and hence to the wheels. So in mechanism the unwanted power loss in the due course of transmission through the differential is reduced. There are some drawbacks in the existing mechanism and we overcome it in the proposed project. The first is while climbing in steep hills the differential is not really needed as the speed of the vehicle is low. And also there are some transmission loses in the differential. So at this time the unit is locked and the loss is overcome. Then when a heavy truck is stuck in a pit or mud it is very difficult to recover the truck as the differential unit cuts the power which is to be transmitted to the wheel stuck. So in this project the unit is disengaged and power is directly given to the axle by pneumatic means and so the recovery is made easier. This is even made use in the vehicle to be driven in the dense forests and even in dessert. Also there will be a ratchet mechanism in the input shaft of the differential to prevent the reverse motion of the vehicle at the driver's will.**

***Index Terms*- Differential, Power loss, Transmission, Steep hills, Ratchet mechanism.**

INTRODUCTION

When a vehicle is negotiating a corner, the outside wheel has to travel a greater distance than the inside wheel. Therefore, the outside wheel must turn faster than the inside wheel. The differential is the device within the axle assembly which, in addition to transmitting the power to each axle shaft/wheel, allows one wheel to turn at a different speed than the other. A conventional open differential sends equal amounts of torque to both axle shafts (top). If one wheel spins because of lost traction, it is sustaining zero engine torque, so zero engine torque is also going to the wheel with traction. Adding a locking differential—in this case a No Spin locker (bottom)—mechanically links the two shafts so that power will be delivered to both axles in all circumstances.

Why You Need a Differential

Car wheels spin at different speeds, especially when turning. You can see from the animation below that each wheel travels a different distance through the turn, and that the inside wheels travel a shorter distance than the outside wheels. Since speed is equal to the distance traveled divided by the time it takes to go that distance, the wheels that travel a shorter distance travel at a lower speed. Also note that the front wheels travel a different distance than the rear wheels. For the non-driven wheels on your car -- the front wheels on a rear-wheel drive car, the back wheels on a front-wheel drive car -- this is not an issue. There is no connection between them, so they spin independently. But the driven wheels are linked together so that a single engine and transmission can turn both wheels.

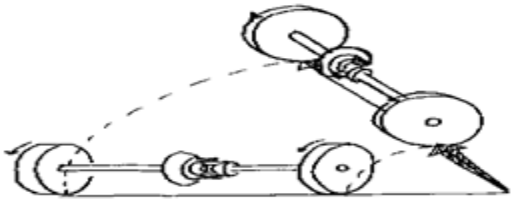


Fig: 1

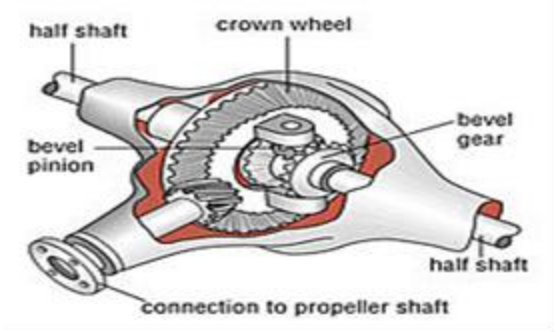


Fig: 2

If your car did not have a differential, the wheels would have to be locked together, forced to spin at the same speed. This would make turning difficult and hard on your car: For the car to be able to turn, one tire would have to slip. With modern tires and concrete roads, a great deal of force is required to make a tire slip. That force would have to be transmitted through the axle from one wheel to another, putting a heavy strain on the axle components.

The Differential Jobs

A. To aim the engine power at the wheels
B. To act as the final gear reduction in the vehicle, slowing the rotational speed of the transmission one final time before it hits the wheels
C. To transmit the power to the wheels while allowing them to rotate at different speeds (This is the one that earned the differential its name.)

Open Differentials

Use two side gears inside the differential case. Each gear is splined to accept an axle shaft. These side gears are in turn driven by a set of spider gears. The spider gears, also inside the differential case, ride on a shaft which is pinned into the differential case and through which all the power is transmitted. The case is driven by the ring gear which is bolted fast to the case. The conventional differential is fitted as standard equipment on most vehicles.

On paved roads this system is very successful, giving predictable handling, even tire wear and requiring very little maintenance. However, in off road situations where traction surfaces vary greatly, this type of differential has a major limitation. When one wheel has greater traction than the other, all the power will be directed to the wheel with the least traction. For example, if one wheel is in the air and the other wheel is still on a hard surface, then all the power will be transferred to the wheel in the air. No power will go to the one on the ground and the vehicle will not move.

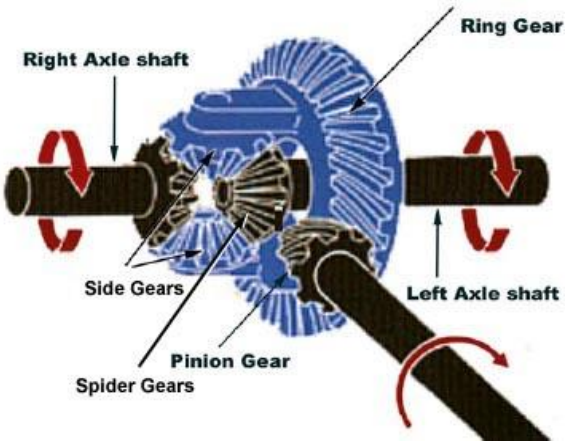


Fig: 3

A. Limited Slips

(LSD's) come in a variety of designs. Most use friction plates, cones and/or gears to reduce slippage between each of the tires. These units have a dual power path from the differential case to the axle shafts. Some power is transmitted through the spider gears to the side gears in the conventional manner. The remainder is transmitted by friction between the differential case and the clutch plates and the side gears. A certain amount of "clutch preload" is built into the unit in a static condition. Then, as load is applied to the differential, the separation forces between the spider gears and the side gears increases this clutch loading. This increase in friction provides for a good positive power flow from the case directly to the side gears. When traction is available to both wheels, the power going to the differential causes the plates to bind tightly together, giving even power to both wheels.

However, in a situation where there is little or no traction available to either one wheel or the other, the amount of power that can be transmitted to the other wheel which has traction is dependent on the friction or "preload" in the clutch plates. High levels of "clutch preload" will result in good torque transfer but some chattering of the clutches during cornering may occur. Lower levels of preload results in minimal chatter but reduced levels of torque transfer to the wheel with traction. Because LSD's restrict true differential action, tire wear is accelerated. Changes in vehicle handling may also occur, particularly in

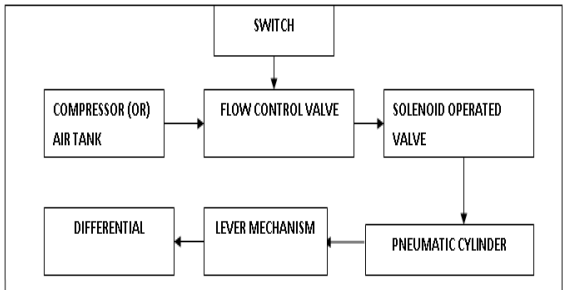
short wheelbase vehicles. Wear rates on limited slip differentials are generally higher than on other types due to the reliance on friction to reduce wheel slippage. Also, special lubricants may be required to minimize rough and noisy operation. Despite their limitations, LSD's are popular as original equipment options as well as an aftermarket replace because:

- Some traction improvement off road is provided
- Vehicle handling idiosyncrasies are not excessive
- Installation is simple
- Cost is reasonable

Working Principle

The main purpose of this project is to lock the differential or to disengage the differential at the time when it is needed to be. So to lock the differential we need to connect the two shafts on the either side so that the differential has no effect on the axle. Now to connect the two shafts we use two circular plates on the either sides of the differential. Both are in such a way that they get mated as soon as possible even in their rotation. So when the pneumatic valve is actuated then one of the plates is pushed to the other so that the plates get mated and hence the shafts are connected. So thus the differential is disengaged. To engage the differential again a spring is used to push the plates apart. Thus this is the working principle of this project.

Design and Drawings



Flow chart for Automatic Differential lock

Fig-4 Photographic View

Fig-5 Ratchet gear tooth view

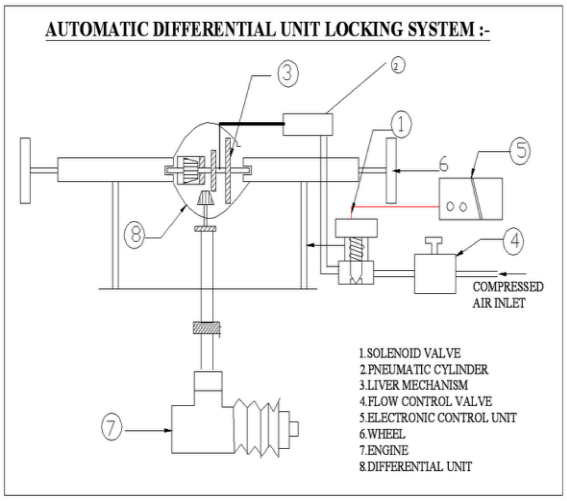


Fig: 6 Automatic Differential Locking Units

LIST OF MATERIALS

Sl.No.	PARTS	Qty.	Material
i.	Auto Diff rential	1	Cast iron
ii.	Single Acting pneumatic Cylinder	1	Mild Steel
iii.	Flow control valve	1	Aluminium
iv.	3/2 Solenoid valve	1	Aluminium
v	Connecting PU Tube	-	Polyurethene
vi	Hose collar and reducer	-	Brass
Vii	Frame	-	Mild Steel
Viii	Dash pad	1	Plastic

Table 1

CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. 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 completed the work with the limited time successfully. The Manually Lockable Differential is working with satisfactory conditions. We are 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 lines about our impression project work.

In concluding the words of our project, since the locking of the differential is very much useful in reducing a considerable amount of loss due the transmission through the differential and also in recovering the heavy trucks from pits in rainy season this could be a source for the above said solutions.

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