

A Review on Improvement of Transmission System of All Wheel Drive All-Terrain Vehicle (ATV)

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ABSTRACT: This paper will give you detailed information about improvement in the design and working of an AWD (All-wheel Drive) transmission system of an ATV (All-Terrain Vehicle). This paper will help in selecting transmission components within an ATV. In this paper, we aim to modify the existing AWD transmission system which includes a selection of transmission components based on track conditions. Our focus is to design AWD transmission system which will give required power output with minimum losses, which will be less in weight, cost and hence will reduce the carbon footprint of the vehicle. This transmission system is having less component which will reduce material and manufacturing costs. Hence vehicle will be cheaper without any compromise in the performance.

KEYWORDS: All Terrain Vehicle, Four Wheel Drive, Two Wheel Drive, All Wheel Drive

I. INTRODUCTION

ATV stands for All-Terrain Vehicle which is capable of performing in off-road conditions such as rocky roadways, soft sand dunes. In this paper, the focus is to modify the transmission system which includes a selection of transmission components based on track. These vehicles are generally used for motorsports, adventure, farming, etc. The transmission system here refers to the system which transmits power from the engine to wheels. These transmissions can be automatic, semi-automatic or manually operated. The various drive type used in ATV are-

A) 2WD (Two-wheel drive)- The vehicle is said to be 2WD if only two wheels get power from engine i.e. front or rear. This Types of two-wheel drive vehicle are

- FWD (Front-wheel Drive)- If the power from the engine is given to front- wheels of the vehicle it is said to be Front-wheel Drive vehicle.
- RWD (Rear-wheel Drive)- If the power from engine is given to Rear-wheels of vehicle it is said to be Rear-wheel Drive vehicle.

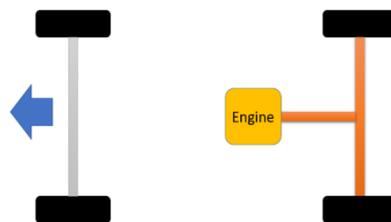


Fig. Rear-wheel drive vehicle

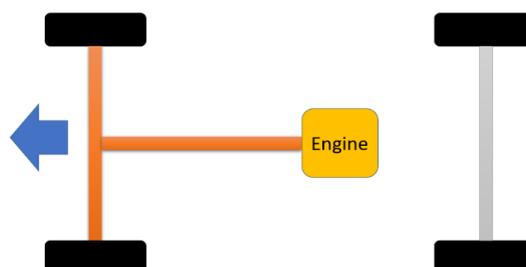


Fig. Front-wheel drive vehicle layout

- A) 4WD (Four-wheel drive)- In four-wheel-drive vehicle power is transmitted to all four wheels. These vehicles generally consist of two differential and one transfer case. In this type of vehicle,drive type can be switched from 4WDto 2WD via transfer case manually or automaticallyon the command of the driver.[1]
- B) AWD (All-wheel Drive)-In all-wheel-drive vehicle power is transmitted to all four wheels all the time. These vehicles generally consist of three differentials in the rear, front and at the centre. The centre differential is to facilitate differences in front and rear torque.[1]

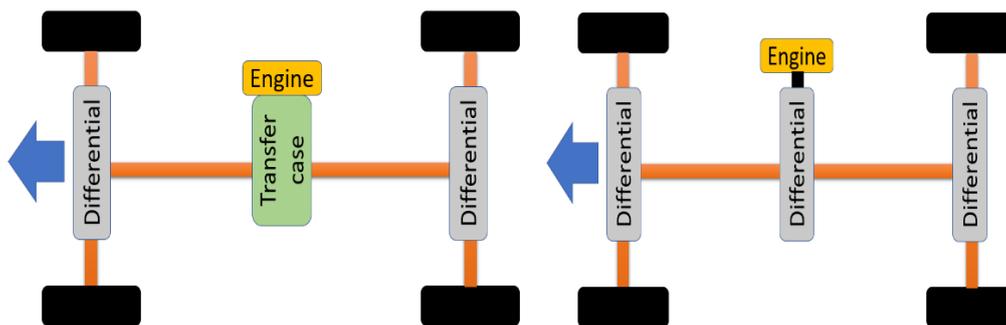


Fig. Four-wheel drive vehicle layout

Fig. All-wheel drive vehicle layout

The device which facilitates front and rear wheels to rotate at different speed while cornering is known as differential. The various types of differentials are-

- A) Open Differential- Open differential allows vehicles to corner without slippage of wheels. This is the simplest and cheapest differential available. The drawback of this differential is that it sends power to the wheel having less traction making it unsuitable for all road conditions.
- B) LSD (Limited slip differential)- This differential allows vehicles to corner without slippage of wheels. This differential overcomes the limitation of the open differential as the power flow to the least traction wheel is limited via different methods such as clutch plates, hydraulic fluids etc.[2]
- C) Spool- The setup which is widely used for serious off-roading is spool setup which is also known as ultimate traction differential. This transmits equal torque to both the wheels all time and hence power losses are reduced.[2]

II. LITERATURE SURVEY

There are various transmission systems available such as automatic, semi-automatic and manual. Out of which we have selected automatic transmission because of ease in shifting gear ratios, hence it is comfortable for the driver. Apart from this automatic transmission systems is not having discontinuity of powerflow like manual and semi-automatic transmission system which will improve the performance of the vehicle. Out of various drive systems available which are 2WD (RWD, FWD), 4WD and AWD. We have selected AWD because

- It gives more traction than 2WD (RWD&FWD) and reduces Slippage because of traction available on all four wheels.
- Proper Weight Distribution on four wheels.
- Off-road Capability

There are various differentials available, some are LSD(Limited Slip Differential),OD(Open Differential),Spool etc whose information are given above. Out of which we are using LSD differential at front and spool at the rear. This is because LSD will facilitate the difference in rpm of front two wheels with optimum torque at each wheel and also it facilitates no torque condition in which one wheel is considered to be in the air with no load on it. The reason for using spool in the rear is its capability of transferring maximum traction or power to wheels, therefore, is known as Ultimate traction differential.This differential is lighter in weight and power losses are minimum. The third differential is there to facilitate differences in rpm of the rear and front wheel. For getting maximum output from spool we have to design

our vehicle with oversteer characteristics. so that while turning one wheel lose traction and allow vehicle to corner with minimum slippage or losses.[4][5]

III. PROBLEM STATEMENT

1. More weight, more material used & hence more carbon footprint.
2. Complexity in design.
3. Hard cornering cannot be done.
4. More turning radius.
5. Less steering response.

IV. PROPOSED DESIGN MODIFICATION

The reason for selecting AWD over other drive types is its off-road capability i.e. more traction and reduced slippage and Proper weight distribution on wheels. In the conventional AWD transmission system, there are three Differential as shown in fig.1. Since we are designing our vehicle for oversteer characteristics we have decided to keep spool for rear wheels. The spool will provide oversteer characteristics. Spool act on the principle of lateral and longitudinal weight transfer which induces while cornering as shown in fig. Since spool will give yaw movement to the vehicle thus we are eliminating the need for 3rd differential.[3]

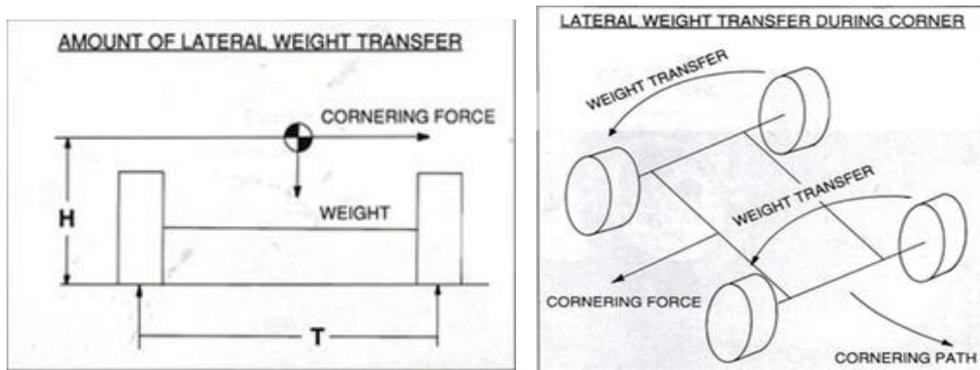


Fig. Cornering force and lateral weight transfer

Also, we will keep first and second differential combines in the same casing which will reduce the material used and hence weight will also get reduced. Using spool will also provide us with maximum traction at the rear with minimum power losses.

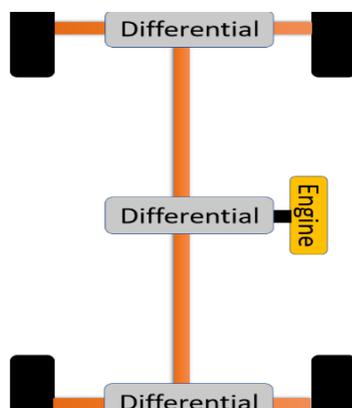


Fig. Conventional All-wheel drive layout

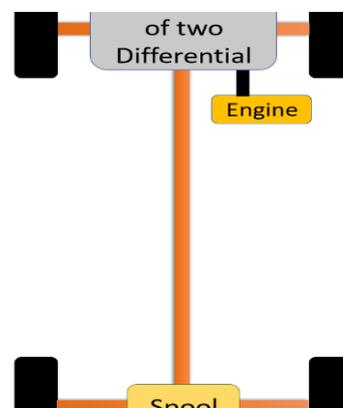


Fig. Modified All-wheel drive layout



V. CONCLUSION

Thus by using the above setup which is spool in the rear and combining first and second differential at the front will help us reduce the weight and hence carbon footprint of the vehicle which will ultimately reduce the material and manufacturing cost. Also, the spool will help in provoking oversteer characteristics and steering response.

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