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Design and Implementation of Cutting Brakes in ATV

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Abstract:

In the emerging field of automobile, safety is the primary concern that the industries are concentrated. Proper braking system is provided for efficient and safe driving. Braking system reduces the speed of the vehicle. For ATV's, proper braking is provided since it travels in rough and slippery conditions. Normally while applying brake, force applied on the pedal creates a pressure in the master cylinder. The pressure in the caliper will be the same and hence all four wheels lock together.

Cutting brakes is locking the rear wheels of the rear wheel drive vehicle individually. Normally supercars are provided with cutting brakes for drifting and for better maneuverability. For ATV, cutting brakes plays a major role for providing sharp turns and to untangle from the slippery conditions. Open differential setup is used for power.

1.INTRODUCTION

In the emerging field of automobile, safety is the primary concern that the industries are concentrated. Proper braking system is provided for efficient and safe driving. Braking system reduces the speed of the vehicle. For ATV's, proper braking is provided since it travels in rough and slippery conditions Normally while applying brake, force applied on the pedal creates a pressure in the master cylinder. The pressure in the caliper will be the same and hence all four wheels lock together Normally supercars are provided with cutting brakes for drifting and for better maneuverability. For ATV, cutting brakes plays a major role for providing sharp turns and to untangle from the slippery conditions. Open differential setup is used for power transmission since it provide equal torque with different speed in the power driven wheels

Brake System

Automotive brakes are designed to slow and stop a vehicle by transforming kinetic (motion) energy into heat energy. As the brake linings contact the drums/rotors they create friction which produces the heat energy. The intensity of the heat is proportional to the vehicle speed, the weight of the vehicle, and the quickness of the stop. Faster speeds, heavier vehicles, and quicker stops equal more heat

Cutting Brakes

Cutting brakes is locking the rear wheels of the rear wheel drive vehicle individually. Normally supercars are provided with cutting brakes for drifting and for better maneuverability. For ATV, cutting brakes plays a major role for providing sharp turns and to untangle from the slippery conditions. Open differential setup is used for power transmission since it provide equal torque with different speed in the power driven wheels.

Basics of Cutting Brakes

Cutting brakes are a system of levers, switches, or pedals that allow you to lock up individual brakes in order to stop one wheel and then use the other wheels to drive the vehicle, thus pivoting around that locked wheel. The result is a tremendously tight turning radius, and they can be implemented in a variety of ways. One thing to be extremely careful with is using cutting brakes at high speeds and on the street, as it can have deadly consequences.

Working Operation

On many tractors the brake is divided into two pedals, one for the left rear wheel and one for the right rear wheel. If you need to stop, you step on both pedals at once. But if you want to turn really sharp, you step on one pedal and turn the steering wheel, and the tractor will spin around the wheel that is locked up.

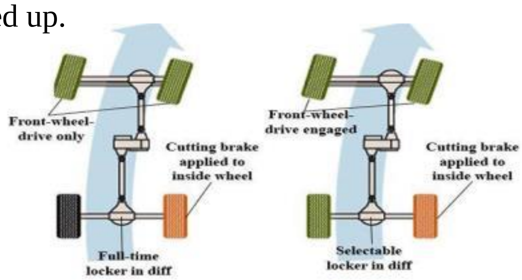

Fig 1.1 cutting brakes

When you want to turn sharply in your 4×4, simply engage a cutting brake for one of the rear wheels and this will let the front axle pull you around the turn. This works very well in a vehicle that either has a selectable rear locker and/or a transfer case that allows you to engage the front axle only. If you have a full-time locker in the rear like a Detroit, you need to engage the front axle only, otherwise the rear tires will drive through the cutting brakes. If you have a rear selectable locker like an ARB, Ox, or E-locker that gives you an open differential when unlocked, you can unlock the rear locker but still engage four-wheel drive when you use one rear cutting brake. This will send the power to the three unlocked wheels and you will pivot around the locked one. In some situations you can achieve an even tighter turning radius if you can unlock the rear locker, put your transfer case in front-wheel-drive only, and lock the cutting brake on the rear tire opposite of the direction you want to turn

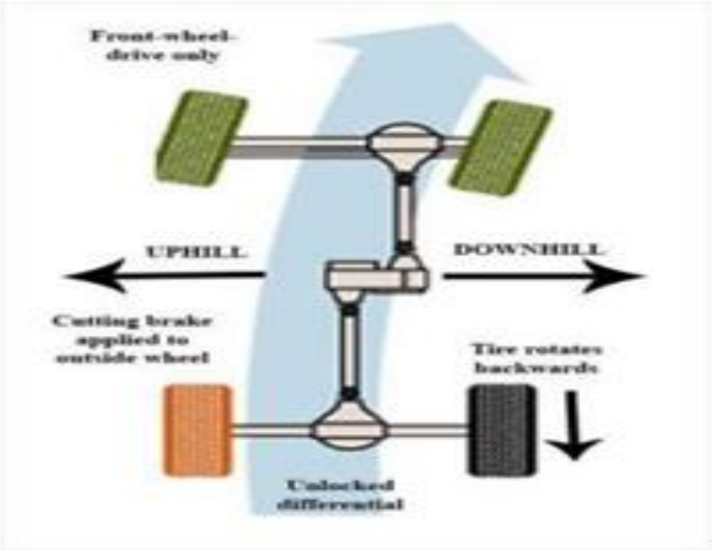

Fig 1.2 cutting brakes during sharp turns

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This will allow the inside rear tire to actually turn backwards as you pivot around the outside rear tire while your front tire s pull you around. However, this maneuver often requires that you be pointed up a hill, and you must let the front tires spin and actualllose traction so you can slide back around the locked tire.Another option is to use cutting brakes as a cheap traction tool. Say you have a cutting brake at each rear wheel, but you do not have a locking differential. You could be driving up a hill and one rear and one front wheel start to spin until you stop moving forward.

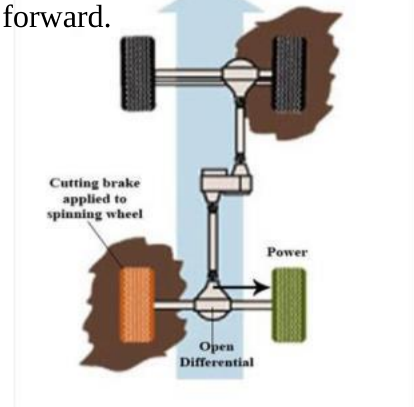


Fig 1.3 cutting brakes in slippery region

By applying the cutting brake to the spinning wheel, the open differential will send power to the other wheel, and if it has traction it will begin pulling you up the hill. This is sort of a poor man's traction control.

Shuttle Valve

A shuttle valve is a type of valve which allows fluid to flow through it from one of two sources. A shuttle valve, also known as a double check valve, allows pressure in a line to be obtained from alternative sources. It is primarily a pneumatic device and is rarely found in hydraulic circuits. The basic structure of a shuttle valve is like a tube with three openings; one on each end, and one in the middle. A ball or other blocking valve element moves freely within the tube. When pressure from a fluid is exerted through an opening on one end it pushes the ball towards the opposite end. This prevents the fluid from travelling through that opening, but allows it to flow through the middle opening. In this way two different sources can provide pressure without the threat of back flow from one source to the other

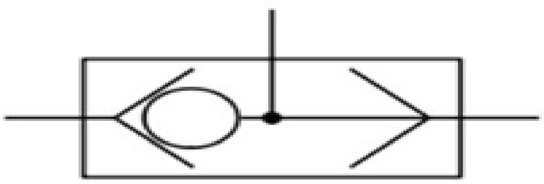


Figure 1.4 Shuttle Valve

Shuttle Valve Necessity

Since the brake circuit becomes more complex using calipers, shuttle valves avoid those complexities. Normally, dual inlet port calipers are used in locking a individual wheel in super cars (one from main circuit and other from cutting brake circuit. Availability of calipers for our prescribed design is a demanding one and manufacturing those calipers to our design will be extravagant.

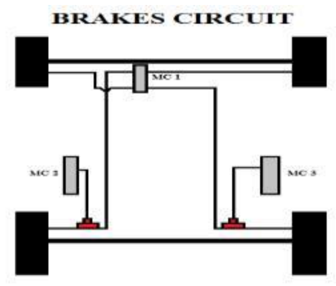


Figure 1.5 Brake Circuit

Brake Circuit

While applying brake, to avoid slipping and dragging, X-split connections are commonly used in four wheelers. When cutting brakes are implemented, circuit connections gets modified with the attachment of shuttle valves, where the one is connected to the brake hose from cutting brake master cylinder, other end from the main circuit master cylinder and the output of the shuttle valve is connected to the caliper attached to the wheel assembly. This makes the circuit simpler and an effective one for proper braking

Assumptions and constants

Mass of the vehicle = 139 Kg (1390 N)

Weight Ration F: R = 1: 2 (Assume front and rear wheel exhibit equal forces)

Wf = 1* 139 = 139 Kg = 1390 N

Wr = 2* 139 = 278 Kg =2780 N

Wf = Weight on the Front Wheel

Wr = Weight on the Rear Wheel Rear axle Load in a factor ‘1’ = 0.6 Height of the CG ‘h’ = 20” = 0.5m

Wheel base, Wb = 1.326m

Ratio, X = L/Wb = 0.377m

Deceleration, a =μ g = 0.4 * 9.81 = 3.924 m/s2

Coefficient of Friction between tyre and terrain, μ = 0.65

Stress Analysis

Stress is defined as load acting per area. Stress analysis gives the amount of stress

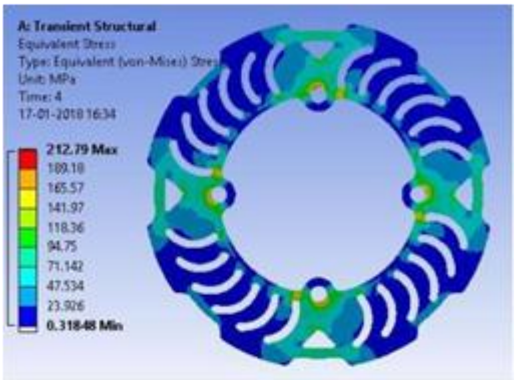


Figure 1..6 Stress Analysis

DISPLACEMENT ANALYSIS

Displacement analysis gives the deformation occurred in each area depending upon the load applied.

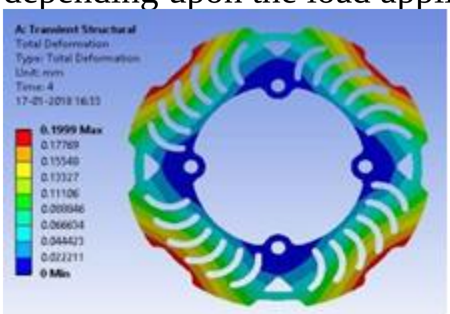


Fig 1.7 Displacement Analysis

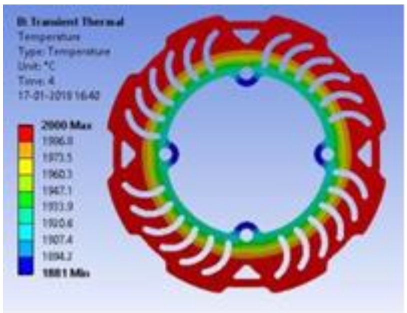
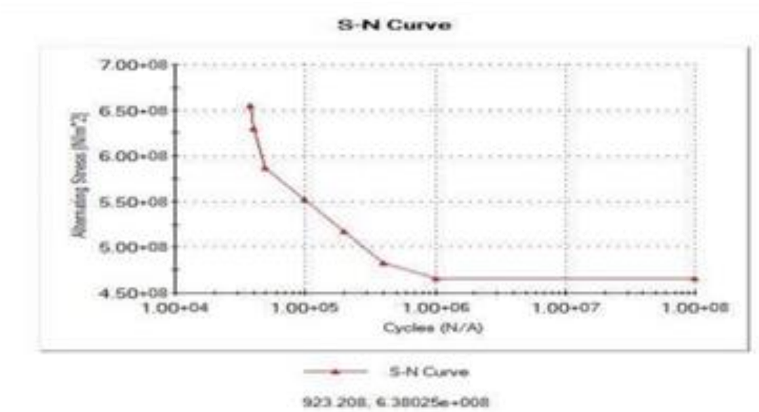


Fig 1.8 temperature analysis

Result

The result obtained by the actual experimentation and the analysis is checked and the results are interpreted. .In ANSYS, the two main solutions are calculated thefirst one is the temperature and the other is the heat flux. The results obtained by ANSYS are reviewed firstly. The contour diagrams for the profiles are given asfollows. The results obtained by the software are verified by the experimentalvalues which are get obtained by the experimental work.the main advantage of thesoftware analysis is that it discretizes the whole model into a small sizedfragments. The boundary conditions are first get applied to the nodes and then thefinal solution is achieved by the addition of individual node. Thus, the results obtained by the software are more precise than the experimental value. There willbe some difference in the experimental value and the software value.S-N curve drawn between stress induced and the number of cycles of load.This curve shows the fatigue strength of the disc. Graph shows a maximum stress



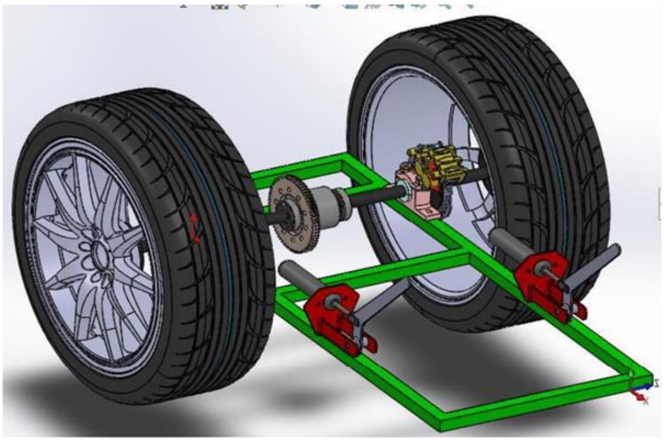


Fig 1.9

The material selection methods for the design and application of automotive brake disc are developed. Functions properties of the brake discs or rotors were considered for the initial screening of the candidate materials using Ashby's materials selection chart. In the digital logic method, the friction coefficient and density were considered twice for determining the performance index and the cost of unit property. This procedure could have overemphasized their effects on the final selection. This could be justifiable in this case as higher friction coefficient and lower density are advantageous from the technical and economical point of view for this type of application. Thus comparing the properties of Cast Iron with Stainless Steel, Stainless steel found to be the better material usage in place of Cast Iron.

CONCLUSION

By implementing the cutting brakes in ATVs, the drawbacks of open differential and limited slip differential is overcome. While turning the vehicle, open differential manage different speed of the two wheels. When one wheel stuck on slippery surface, that wheel is locked by means of cutting brakes. Thus the torque is distributed to the wheel which is in traction with the ground and the brake disc is effectively customized and analyzed in the ANSYS software

REFERENCES

1.Active Safety Braking System: International Journal of Scientific and Research Publications , Vallamkondu Arun Kumar

2.Enhancement of Braking System in Automobile Using Electromagnetic Braking: IOSR Journal of Mechanical and Civil Engineering. Akshyakumar S.Puttewar , Nagnath U. Kakde , Huzaifa A. Fidvi , Bhushan Nandeshwar.

3 Research of vehicle brake efficiency: Procedia Engineering , Vytenis Surblys ,Edgar Sokolovskij2

4. Thiagu S.M, Braking system of All Terrain Vehicle (ATV): International Journal of Mechanical Engineering and Technology (IJMET), Kancharana Sunil , J.Kranthi Kiran , G.Varun Reddy.

5.Designing of All Terrain Vehicle(ATV): International Journal of Scientific and Research Publications, Deep Shrivastava