REVIEW ON ADVANCEMENTS IN HYDRAULIC BRAKING SYSTEM IN TRACTOR TROLLEY

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Abstract: The tractor trolley is a detachable trolley carrying loads around 6-7 tons. It is found that due to excessive load carried out on the trolley in India there are uncertain or unrequired jerks on the tractor. The tractor and the trolley have the possibility to breakdown or fall. This causes harm on the driver, road, and the life of the people who are around the tractor while accident takes place. The mechanism is totally dependent on the braking system, where the only difference is that the normal trolleys axle is been changed with the new axle and the front portion of the trolley i.e. the connecting rod of the trolley and tractor is been given an additional component. This component is the master cylinder which is the main component to operate the brakes. When the tractor applies an urgent brake due to inertia it comes over the tractor. As it comes in front the spring compresses and the rod moves in front, moving the piston rod. As the piston pushes the oil forward it applies the brakes. And the trolley stops with the tractor. The accidents are avoided with it.

Index Terms **- Hydraulic Brake, Tractor Trolley, Master cylinder, Helical spring**

I. INTRODUCTION

Farm vehicles like any other vehicle must comply with Road Traffic Regulations, a lot of which have been in Legislation since the 1960's. The increasing number of fatalities on our roads, together with the demand for action on road safety, has resulted in stricter enforcement of these regulations. Many farmers and contractors are discovering that their trailers do not fulfill the requirements laid down in the Road Traffic Regulations. The need for such braking system is even more important with the introduction of 30 km/h tractors. The service brakes of the tractor and those of the trailer are required to be operated simultaneously by a single control (brake pedal).The service brakes on trailers are either of the hydraulic or air type. Hydraulic braking system would be adequate up to 30 km/h. An efficient vehicle braking system is central to safety during transport operations, be they on or off-road, but agricultural trailer (and trailed appliance) braking systems are frequently given insufficient consideration, both at the time of purchase and subsequent level of in-service maintenance frequently now proving to be inadequate for safe use behind modern 'conventional' tractors. As safety feature in any vehicle plays the vital role in designing that vehicle. Braking system in any vehicle is thus must be designed with accuracy. The tractors used are nearly driven with speed of 30 km/h. Tractor Trolley's used in now a-days vehicle are without brakes various loads are applied on trolleys when it is loaded. During the inclinations stresses are developed on the joint between the tractor & trolley. This may cause the deformation of the joint due to stresses. In order to avoid all these problems, there is a need to apply brakes on the trolley also. In the project an analysis of different braking systems would be done and a suitable braking system would be identified for the trolley. The most suitable braking system for the trolleys would be a hydraulic braking with the introduction of fifth wheel to connect the tractor with the trolley. The fifth wheel will assure the required constrained relative motion of the trolley with the tractor. The project work includes design of various components of the hydraulic brakes and the selection of fifth wheel coupling from the standard lot. A CAD model of the entire system will be made We Use Hydraulic Braking System In Trolley: - The speed of tractor is generally up to 40kph. So for this speed limit use of hydraulic braking system in trolley is proper. The hydraulic brake system should be applied smoothly on trolley. The hydraulic braking system has not been damaged in any way & the connection can be than the air brake systems. Hydraulic fluid should be in-compressible. Also the hydraulic system should be air tight such that no vapor is introduced in the system. Hydraulic fluid must resist vaporization at high temperatures. The fluid that is used should be non-corrosive for the surrounding material.

II. PROBLEM STATEMENT:

A common problem within the industry is when tractors are pulling heavy loads up steep gradients, the tractor engine stalls & the operator then has no means of braking the whole combination. It then has the potential to run backwards at ever increasing speed. The agricultural vehicles' speed requires efficient braking system.

The difficulties faced by the driver while driving the tractor with excessive load on the trolley are as follows:-

a. Cannot apply sudden brakes
b. Trolley falls down
c. Tractor cannot move on high speed

On slopes trolley starts unbalancing due to which it falls on the tractor and the life of driver is at risk.

III. OBJECTIVES:

1. In order to lesser the accidents happens due to lack of braking system in the tractor trolley.
2. As hydraulic braking system is used quick results may be obtained.
3. Used as a life saver project as 80% of the accidents are stop from happening
4. Mostly applicable in agricultural field but can also be used in other fields.

IV. LITERATURE SURVEY

[1] Jasna Glisovic Jovanka Lukic et.al. The aim of this paper is to describe the FE modelling of wet multiple-disc brakes and their brake performances. As agricultural tractor size and speeds have increased during recent years, heavier loads are transported on public roads at higher speeds. With the combination of higher-energy level and more rapid deceleration, brake systems with excellent heat dissipation characteristics are required. Wet multiple-disc brakes have similar multiple disc construction, but operate in an oil bath. ABS is the next step in the development of a brake system of the tractor that brings an additional level of safety and control. In addition to the illustrations of development trends of the various components of the braking system of agricultural tractors and trailers. There is a tendency worldwide to improve tractor's transporting performance by increasing tractor speed. Faster, bigger, more powerful and more maneuverable machines are capable of developing ever higher speeds. Nevertheless, the increase of the agricultural vehicles' speed requires efficient braking system that should enable agricultural vehicles to keep the pace with the other fast vehicles participant in road traffic, taking into account traffic safety.

[2] Zbigniew Kamiński et.al. The developed computer model is used to study transient processes in the air braking system of agricultural tractors equipped with hydraulic brakes and to predict the dynamic properties of the air braking system of tractor-trailer units (speed and the synchrony of action) using simulation methods. A typical air braking system of an agricultural tractor consists of two major parts: an energy supply unit and a control device. The role of the energy supply unit is to purify and compress the air and to maintain the adequate pressure in the tractor and trailer reservoirs so that the required trailer braking performance is ensured. The control device permits a smooth gradual braking process for the tractor-trailer combinations. The co-operation of the tractor hydraulic braking system and the trailer air braking system is provided by a hydraulically actuated trailer brake control valve.

[3] Geovana P. Drumond and Marysilvia F. Costa et.al. This paper talks about hydraulic hoses. Hydraulic hoses are components of subsea umbilical's that are responsible for Xmas tree gate valves actuation. These hoses are susceptible to collapse by external pressure and, since they are fabricated of rigid polymers, this failure can lead to strain concentration at specific points across the circumference, leading to rupture due to high internal pressure. Therefore, the objective of this work is to study an alternative material to be employed in the manufacture of the hydraulic hose liner that can support the internal pressure (associated to the aramid layer) after an eventual collapse, and that have no chemical interaction with the hydraulic fluid driven by the hose. This study is based on the comparison between the material currently used (Polyamide 11) and a fluorinated elastomer, Viton®. To compare the mechanical behavior of both materials, uniaxial tensile tests as well as nonlinear finite elements models were performed. The results obtained by finite element analysis showed that both, Polyamide 11 and Viton®, did not fail under external pressure.

[4] Manish Digambar Toprakwar et.al. In this paper of modeling analysis and optimization of master cylinder of hydraulic breaking system are performed and conclude that the polyimide is an alternative material for aluminum which can be used in automobile manufacturing. The weight of master cylinder made up of polyimide i.e. 0.1 49 kg is less than master cylinder made up of Aluminum i.e. 0.282 kg. The stress induced in aluminum master cylinder is more than the stress induced in master cylinder made up of polyimide material as well as the induced stress in polyimide material is very less compared to ultimate strength of that material. The quest for an engine to increase mileage has started before many years .Many automobile manufacturing industries are doing more research on how to increase mileage of vehicle. In today's automobile competition every manufacturer is focusing on weight reduction of vehicle by considering this objective, this paper focuses on providing alternative material. The objective of the present work is to optimize weight reduction to increase mileage of vehicle. Saving grams at different parts in a car helps us in saving some kilograms at the end of the design. Also the main material like polyimide for automobile component manufacturing can be the best alternative solution in all respect. The focus of this paper is on weight reduction of master cylinder. For modeling and analysis PRO-E and ANSYS is used. The results obtained are comparatively better than existing materials and polyimide can be the alternative solution for automotive component. Braking system is a means of converting momentum into heat energy by creating friction in the wheel brakes.

[5] **Muyi Lin, & Wenfeng Qu et.al.** It is the first step as well as an important basis in evaluating the safety of the running vehicles to know the dynamic property of the brake valve in the study of the whole vehicle brake property; it is also significant to the optimum match of the brake system and the other parts or other system of the car, to the design of the whole hydraulic brake system and to the longer use of parts and components. The experiment on the dynamic property of brake valve is also helpful to obtaining some calculating parameters that are impossible in theoretic analysis, so that the total analysis is possible on the effect of brake valve structure parameters and application conditions on the hydraulic property, and the foundation for further theoretic analysis and model imitation is established.

[6] KHAING KHAING WAI, NYEIN AYE SAN and HLA MIN TUN et.al. It can be concluded that the smaller diameter of wheel cylinder gives the less force required drum brake due to the 40% of weight transfer effect in braking condition and good condition of brake efficiency in down-hill position. According to hydraulic principle, if there is no leakage in the brake line, the pressure at the wheel cylinder will be the same as the pressure from the master cylinder. The heat generation of braking system may also be obtained by considering the amount of kinetic and potential energies which is absorbed. In brakes, it is very difficult

to precisely calculate the temperature rise. The temperature rise of brake drum causes the high wear rate of brake lining and the brake life will be low. Therefore, the temperature rise should be kept within the permissible range.

[7] MOHAMMED ABDUL ALEEM, ASRAR AHMED SAAD et.al. A brake is a mechanical device which inhibits motion. A drum brake is a brake that uses friction caused by a set of shoes or pads that press against a rotating drum shaped part called a brake drum. The brake drum is a critical component that experiences high temperatures and develop thermal stresses during application of brakes. In addition, the application of shoe pressure gives rise to mechanical loads. So the analysis takes into account both the displacement loads and mechanical stresses together. Brakes in cars and trucks are safety parts. Requirements not only in performance but also in comfort, serviceability and working lifetime are high and rising; i.e. the brake pad with the friction material, the counter body and caliper, can be modeled. When the brake is applied repeatedly the brake pad undergoes critical stresses to determine the critical stresses the structural analysis is carried out. In my thesis, I focus on the analysis of the brake shoes and its components.

[8] Ramamurti V, Sukumar T and Mithun S et.al. It is observed that while driving and while braking, the rim experiences a maximum stress of 35MPa and 36MPa, the hub 20 and 16MPa and the drum 1.7 and 16MPa. This is on the assumption that the drive and brake torque are not varying with time, since these are transient in nature the actual stress experienced are likely to approximately twice the values computed.. There are no documented values of temperature variation available. If this taken into account the maximum stress experienced by the drum is likely to be much higher than 16MPa.Stress analysis connected with the brake assembly of heavy vehicles is a complicated problem in view of the machine elements involved. The hub (on the rear axle), the rim (holding the wheel) and the drum (holding the brake shoe) experience severity of loads. While the vehicle is being driven the power is transmitted from the hub to the rim. When the brake is applied, the brake drum receives the braking torque and communicates it to the rim. Analysis associated with braking is actually transient since the braking torque varies with time in a short period of time whereas the one associated with driving is predominantly steady while the vehicle moves with uniform speed.

[9] Avinash A. Mangale and U.D. Gulhane et.al. The hydraulic braking system designed for tractor trailer is similar to that used in other four wheeler vehicles like Mini trucks, Cars, Bus, etc. The standard components like Master cylinder, Tandem cylinder, Brakes shoes, and liners have been designed and selected. The main purpose was to synchronize braking of trailer with braking of engine wheels. The synchronization will be possible through the use of Fifth wheel coupling. The design and selection of standard braking system components along with fifth wheel coupling is finalized. The trolleys are more prone accidents due to various reasons. Most common reason in absence of any standard braking system. The design of braking system for four-wheeler Trolley have been done and presented. For synchronization of motion between tractor engine and trolley a concept of fifth wheel coupling have been incorporated. The standard fifth wheel couplings have been designed and planned. The necessary changes will be made in hydraulic circuit of the tractor

[10] ER. Amitesh Kumar et.al. Hydraulic regenerative braking system is an important branch of hybrid technology, which has the advantage of high power density and the ability to accept the high rates/high frequencies of charging and discharging, therefore hydraulic regenerative braking technology is well suited for off-road vehicles and heavy-duty trucks. Relatively lower energy density and complicated coordinating operation between two power sources require a special energy control strategy to maximize the fuel saving potential. This paper presents a new configuration of parallel hydraulic regenerative vehicle (PHRBV) to improve the braking energy regenerated potential and engine work efficiency. Based on the analysis of optimal energy distribution for the proposed PHRBV over a representative urban driving cycle, a fuzzy torque control strategy based on the vehicle load changes is developed to real-time control the energy distribution for the proposed PHRBV. Simulation results demonstrate that the proposed PHRBV with torque control strategy takes advantage of the high power density and efficiency characteristics of the hydraulic regenerative braking system minimizes the disadvantages of low energy density and effectively improves the fuel economy of PHRBV.

[11] C.D Stewart and D.G. Gorman et.al The effects of 'pin-hole' failure of one pressurized hydraulic hose on its neighbour are investigated. A pressurized test hose was inserted into a custom testing apparatus and subjected to a series of ten short duration liquid impacts simulating the pin-hole failure of an initial hose. Subsequent displacements of the hose were filmed and plotted with respect to time. Three distinct pattern groups emerged which were used to explain the resultant damage to the hose. It was observed that the middle pattern, corresponding to impacts 6 and 7, appears to be the point where the very damaging hydraulic penetration mechanism became dominant and the outer layer of the hose failed. On completion of the ten impact series it was observed that a small hole on the outer surface of the hose gave way to a relatively large damaged area in the strength bearing inner braid material.

[12] Pier Giuseppe Anselma and Giovanni Belingardi et.al A design methodology that enables quick development of hydraulic brake systems for light vehicles is presented. The brake system is modeled through analytical equations for each component. Safety standard homologation requirements are presented and analyzed. After each test is considered to establish design targets, a procedure is proposed to develop the brake system meeting the standard requirements. MS-EXCEL software is involved to quickly observe the impact of changes of the design parameters on the system performance. The developed tool is tested by quickly coming up with effective brake systems for four actual vehicles

[13] Mircea Nastasoiu1 and Nicolae Ispas1 et,al The mathematical model elaborated is general. It allows the determination of braking parameters for all types of wheeled tractors (4 × 2 and 4 × 4) and for various types of soil, characterized through both the coefficient of road adhesion and the coefficient of rolling resistance. Similarly, the mathematical model enables us to carry out analyses into the braking system performance considering the two braking systems versions: 1) braking applied on the rear axle and 2) braking applied on all four wheels. Likewise, this mathematical model enables us to determine the braking performances of the tractor-trailer systems. For a particular braking version, the braking parameters depend on the initial braking speed and on the coefficient of road adhesion. When brakes are applied on all four wheels the braking performance parameters are considerably

improved. For example, in the cases submitted to analysis, the maximum deceleration increases by 24...28%, the braking time decreases by similar per cent and the braking distance also decreases by 55...66% . The mathematical model also shows that the braking performances of the tractor-trailer system depend on the trailer braking system and on the ratio between the trailer's mass and tractor's mass. We mention that we did not adopt a maximum constant value, as is usually the case. A time dependent variable value was adopted

[14] David E. Keyser et.al This paper reviewed basic concepts involved in designing full power hydraulic brake actuation systems for off-road vehicles and equipment. The design process is challenging and complex with operator safety being the primary concern. The reliability and economy of the design depends directly upon the quality of the data and the accuracy of the system designer. Designing a brake actuation circuit involves many factors including analysing design prerequisites, determining brake system needs based on vehicle specifications, integrating actuation circuits into existing hydraulic systems, being aware of potential problems in the brake actuation design and many other variables. It is the vehicle designer's responsibility to insure a proper testing program is defined and conducted to insure validation of the components selected. It is essential to have a thorough understanding of not only components and circuits but also the many laws, organizations and agencies that regulate vehicle braking and system design. The importance of planning cannot be overemphasized

[15] Qinghe Liu, Lan Zhan and Ti He et.al We raise a proposal of electro hydraulic composite brake system, which is based on the high-speed switching valve, and verify the feasibility of the electro hydraulic braking system through tests. An algorithm of the composite braking force distribution is set up, according to the law of ECE and motor's external characteristic. Based on the ADVISOR simulator, the electro hydraulic composite brake system's braking strategy is simulated, and according to the simulation result, the braking safety and the amount of regenerative braking energy are analysed.

V. Experimental Setup:

The basic idea of a Hydraulic regenerative braking system is that when the vehicle slows down or decelerates, it will store the kinetic energy that was originally momentum as potential energy in the form of pressure. This is done by using a displacement pump to pump hydraulic fluid into an accumulator. When the vehicle accelerates, the pressure is released from the accumulator which will spin the drive shaft and accelerate the vehicle. Thus the engine remains idle while the pressure is released and when the accumulator is empty, or the desired speed is achieved, the engine will then engage in order to maintain a constant velocity, or to accelerate the vehicle beyond what the capacity of the accumulator was capable of. There are tons of load carried by the trolley, on the road. The trolley moves with the help of the tractor. The master cylinder is been placed after the bolt and the spring. During the moment of the tractor the trolley is also moved along. And with which the bolt moves through tends to move forward. Expected modelling of tractor trolley. When it moves forward the I-bolt and rod which is connected to the tractor also moves and gives jerk. This jerk and sudden impact is absorbed by the spring. The rod moves inside, attached to the piston of the master cylinder, the piston moves along with it. The piston moves and the fluid is passed into the wheel cylinder and shoes is operated. When shoes are operated the brakes are applied and our project is successfully worked out. We are using this type of hydraulic braking system because of simplest working and affordable.

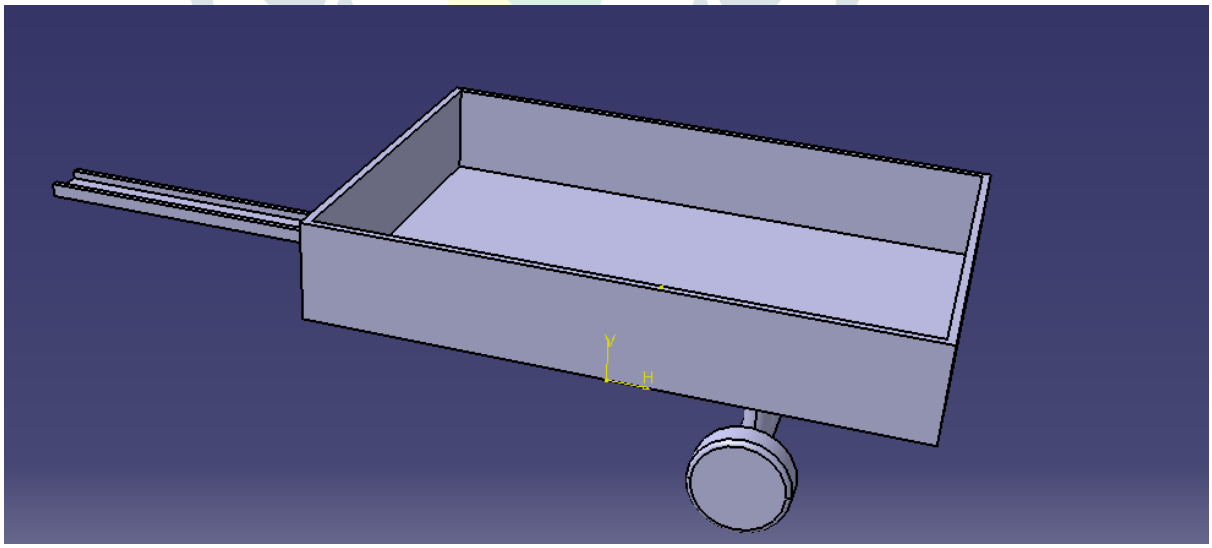

Figure 1 Trolley

Figure 2 Master cylinder

VI. CONCLUSION:

Hydraulic hybrid technology has the advantage of high power density and the ability to accept the high rates/high frequencies of charging and discharging, therefore it is well suited for off-road vehicles and heavy duty trucks.

The innovative design of our project was to avoid the problems caused in the tractor trolley. This helps to minimize the disasters faced below.

- Cannot apply sudden brakes
- Trolley falls down
- Tractor cannot overtake on highway
- Tractor cannot move on high speed

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