

Implementation of Self Adjusting Brakes in Tractor

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Abstract- The Braking system is the majorly considered to be the important feature of safety equipment of the automobile. Brakes are the which are used for stopping or slowing down the automobile, and they are the main reason for avoiding collisions between the automobiles in the road. This paper brings about the simple advancement of braking system used in the tractor, and the current technology used in braking of tractor and their pros and cons and the types of classification of brakes used in the tractors. The tractors usually work in the dry/wet puddling field for about 8 hrs, or more the they tend to move in one direction either right hand side (RH) or left hand side (LH) due to this the brakes used to wear out fast and in need of changing brake pad very frequently. After the puddling operation the Haulage (Tractor-trailer) attachment it tends to go in a straight road but due to wear out of brakes, steering control is not proper so handle this problem of over steering towards to the ends due to wear out of the brakes. A solution should be brought in the name of self-adjusting brakes in the tractors for balancing steering condition well on the road.

Index Terms- Braking system, Brakes, Tractor Braking system, Steering control of tractor.

1. INTRODUCTION

The Tractor braking system usually same as the other automobile they do not differ as they the same type of brakes system, tractors also use actuators system for braking too they are the combination of pneumatic, hydraulic and mechanical brakes. The brakes are classified into

- Fully hydraulic
- Vacuum assisted hydraulic
- Air assisted hydraulic
- Air brakes
- Mechanical brakes -tractors
- Hydraulic actuated brakes-tractors

1.1 Braking System in Tractor

The Tractor layout shows the total reactions occurring in the tractor while braking is done or the total of the reactions involved in it This figure below represents the nomenclature of braking system

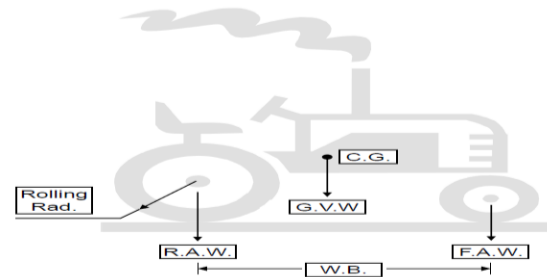


Figure 1.1 Tractor nomenclature

- Front axle weight
- Rear axle weight
- Centre of gravity
- Gross vehicle weight
- Wheel base
- Tyre rolling radius

Major weight of the tractor is on the rear wheel, Thus the wheel torque achieved is much higher than that in the front because of those huge big tyres. Hence braking is possible only in the rear wheels

$$Br. Force = GVW \times Decel.$$

$$Torque = \frac{GVW \times Decel \times Rol. Rad.}{Rd. Ratio \times 2}$$

Wheel Torque

The wheel lock occurs only when the condition that the wheel torques is equal to the torque produced by the brake pedal of the tractor and other automobile.

1.2 TYPES OF BRAKES:

The Tractor brakes are based upon the older technology like the hydraulic and mechanical brakes as they provide better efficiency to the braking system. so the brakes used in the tractor are classified into two types according to their convenience of usage such as the

- Mechanical brakes
- Hydraulic brakes

1.2.1 MECHANICAL BRAKES:

Mechanical brakes are the system which uses cams and other link mechanism to operate or manipulate the braking lever with the usage of timing or non-timing, though there is no electronic brakes present in tractor. so the tractor uses mechanical brakes which operate by usage of both cam and link actuated, the mechanical brakes can be classified into three types of braking techniques or the system such as

- Internal expanding shoe type
- External contracting shoe type
- Disc type

INTERNAL EXPANDING SHOE TYPE:

In this brake type two brake shoes which are made up of frictional material which is fitted in the inside of the brake drum by the help of mean springs. Each shoe side of one end is made out to be a fulcrum, where the other side of the two brakes is free and easily can be actuated by the usage of cam which shows the application of brake shoes which turns the frictional force in the shoes. The main movement of the linkage of this brake type is caused by a pedal which is connected through a linkage. The drum which is been fixed on the rear axle where the shoe assembly stay stationary and thus mounted on a back plate

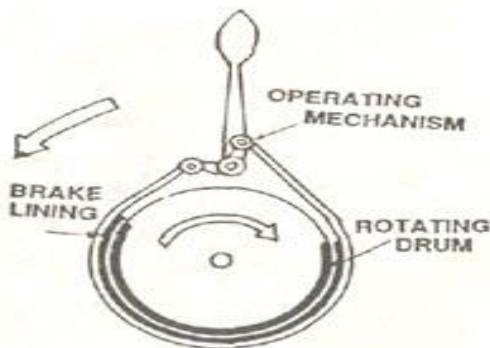


Figure 1.1 Mechanical Brakes

EXTERNAL CONTRACTING SHOE TYPE:

This type of brakes is used only in the crawler type of tractor; the brake band is directly surrounded by the drum which is mounted on the drive axle. When the brakes are being depressed, the band which is present tightens the drum. These are not actually used in the normal tractors right now

DISC TYPE:

This type of braking system is currently used in the braking system right now, such the disc type of braking is that it has two actuating which has been drilled in the disc where a hole is created and thus a ball present in the disc are pressed. When the brake is being depressed, the link which helps the brake to move the two side of the discs to their operations which are in opposite direction. The steel balls which are present thus allow to shallow parts of the holes drilled in the disc plate. As a result, in which the two discs are being to the expanding and the braking discs are pressed between the stationary and disc housing. The disc braking system which are directly mounted on the shaft of the differential shaft, which ultimately the travelling effect to the different differential shaft of the tractor. The disc brakes are classified into two types of disc brake system such according to the properties are named such as the

- Dry brake
- Wet brake

DRY BRAKE:

This the dry disc brake model such that this is the cam operated braking system in which the braking is actuated in linkage type of operation, and linear material used here is the asbestos and non-asbestos

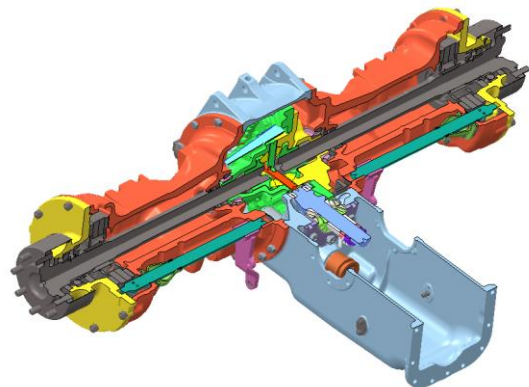


Figure 1.2 Dry Disc Brake

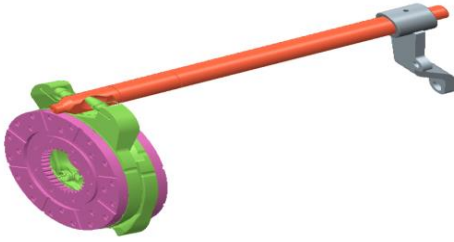


Figure 1.3 Side View of dry disc brake

WET BRAKE:

This type of braking system differs from the dry disc brake operating system such that this the link operating brakes, where these are the oil immersed brakes, and there are also actuated due to the linkages actuation and the liner material used here is the non-asbestos.

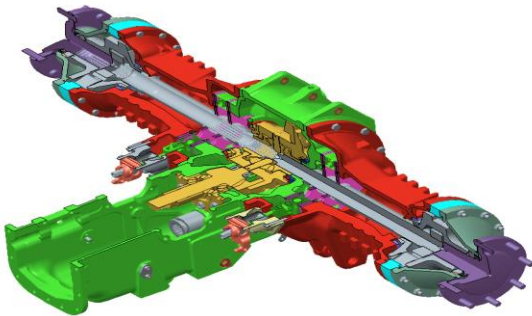


Figure 1.4 Wet brake

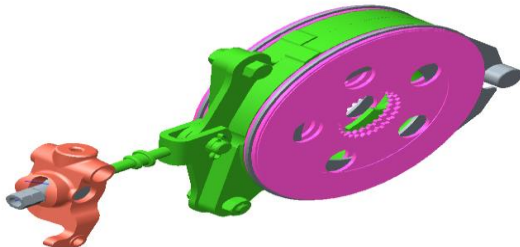


Figure 1.5 Side view of wet brake

1.2.2 HYDRAULIC BRAKE:

Hydraulic brake system is based upon the principle about the Pascal's law. The brake fluid, which is used in the brake actuation is usually a mixture of alcohol and glycerin, it is the filler material which is filled into the master cylinder. When the pedal is pressed, the piston of the master cylinder is being forced into the cylinder of the braking system and in which the entire system turns into a pressure system. Immediately, the wheel cylinder piston slides outward which moves the brake shoes to make retard the drum or completely stop the rotating drum. When

the pedal is released, the return spring of the master cylinder which will automatically move the piston back to the initial position.

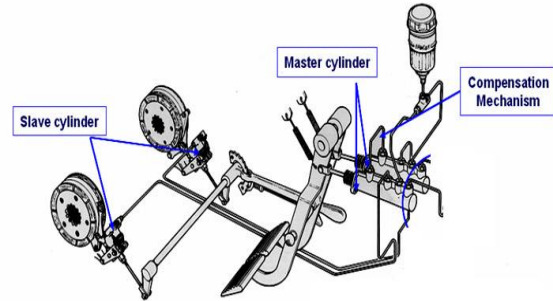


Figure 1.6 Hydraulic brake

This hydraulic brakes are the wet disc brake of the tractor which is the OIB known as the Oil Immersed Brake where this brake is operated by the link operating system in which the hydraulic actuation occurs and the liner material is used here is non asbestos

2. NEED OF SELF BALANCING BRAKES

During Dry Puddling/Wet Puddling application, due to Land positions and driver's comfort zone, Either side (LH/RH) turning is being operated for long duration of time thru one side brake operation (instead of steering). (I.e.) LH side turning is being done for 6 Hrs etc. During this period, the one side Brake pad is getting fast wear than the opposite side Brake pad due to the above said usage pattern. After this Puddling cultivation is over, during Haulage (Tractor + Trailer), the tractor is being operated in Straight road condition. That time, the occurrence of One side brake pulling is eminent which may lead to untoward incidents due to uneven brake pad wear to avoid this, Brake adjustments has to be done, presently it is being done by manually. Manual adjustment by customer would lead to over adjustment which might stall the vehicle/Jam the Brake or Lead to under adjustment which might be having brake efficiency issues. Hence, Self-adjusted brakes have to be provided for better operation. To avoid this uneven brake wear during change in off-road and on road usage, Self-adjusted brakes would be an ideal solution thereby manual adjustment can be eliminated which will improve the overall driving comfort. Where the manually changing of the brakes are not possible which can't be done so easily such

that the braking system is been changing of the brakes are temporal solution is to be brought out.

3. PROBLEM ARISED

The main problem in the braking system is the uneven changing of the brakes actuating piston unit in which in thus represented in the following diagram such the due to continues riding tractor on one sided fully either the left hand side and the right hand side

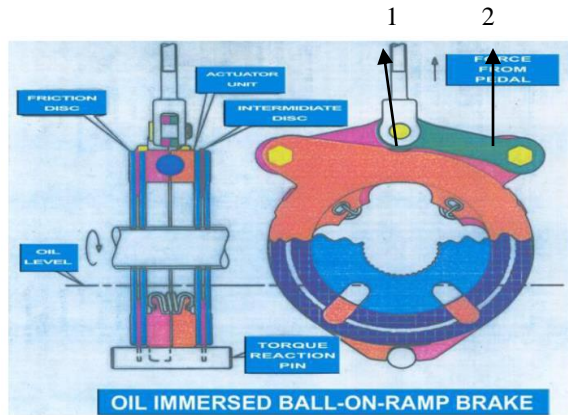


Figure 3.1 Wet brake (OIB)

The 1,2 represents the linkage of the braking system such that the when due to constant stepping on the brakes for too long on sided it makes the 1 part go higher or deeper according to the usage of brakes and this makes uneven transition of brake surround the braking system

After puddling operation, the tractor brakes are locked such that the road condition such that the brake pedal which actuates the simultaneous of the both brakes such that anyone side is deep so that the if brakes are applied in that condition even in a straight road the tractor tends to move in the right side deeper or the left side deeper such that steering control will not be stable such that the to fix this condition manually brakes pads are changed or the lever is pulled over to the initial position using mechanical ram or any push and pull rods

Manual adjustment by customer would lead to over adjustment which might stall the vehicle/Jam the Brake or Lead to under adjustment which might be having brake efficiency issues. To avoid this uneven brake wear during change in off-road and on road usage, Self-adjusted brakes would be an ideal solution thereby manual adjustment can be eliminated which will improve the overall driving comfort

4. ALTERNATIVE MECHANISM:

To prevent this from happening is that to maintain the lever falling from initial position such that the brakes is not subjected to manually repair the brake periodically. The lever should not be lowered from the initial position of both sides such that a mechanism is to be provided in it such that lever won't be dropped. The mechanism used here is the ratchet mechanism which to be can be an alternative for braking system

4.1 RATCHET MECHANISM:

A ratchet is a mechanical device that allows continuous linear or rotary motion in only one direction while preventing motion in the opposite direction. Ratchets are widely used in machinery and tools. Though something of ratcheting socket wrenches, a common tool with a ratcheting handle.

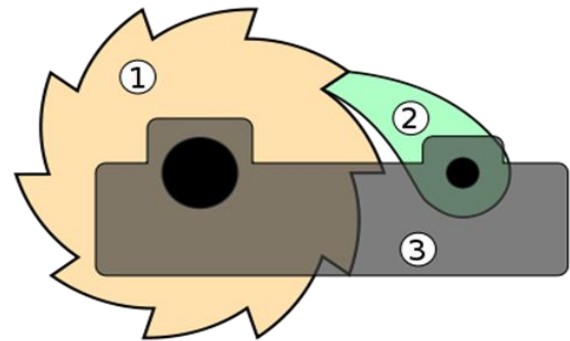


Figure 4.1 Ratchet

A ratchet consists of a round gear or linear rack with teeth, and a pivoting, spring-loaded finger called a pawl that engages the teeth. The teeth are in asymmetrical shape, with each tooth having a slope on one edge of the ratchet and a much slope which is steeper on the other edge. When the teeth are moving in the unrestricted i.e., forward direction, the pawl easily slides up and over the gently sloped edges of the teeth, with a spring forcing it often with an audible seeing into the depression between the teeth and tip of each tooth. When the teeth move in the opposite backward direction, however, the pawl will catch against the steeply sloped edge of the first tooth it encounters, thereby locking it against the tooth and preventing any further motion in that direction Because the ratchet can only stop backward motion at discrete points (i.e., at tooth boundaries), a ratchet does allow a limited amount of backward motion. This backward motion which is limited to a maximum distance equal to the spacing between the

teeth is called backlash. In cases where minimization of backlash is required, a smooth, a high friction surface of toothless ratchet such as rubber is used sometimes. The pawl bears against the angled surface so that any backward motion will cause the pawl to jam against the surface and thus prevent any further backward motion.

5. DESIGN EXPLANATION

As the main problem is such that two links of 1,2 which is shown in figure 4.1 should be maintained at a study level such that continuous use of haulage these modifications are being made in three sections such as the

- Swing arm
- Spring
- Ratchet pin

By implementing this the brake is modified and we'll be suitable for better conditions such as the braking conditions as well as the steering condition

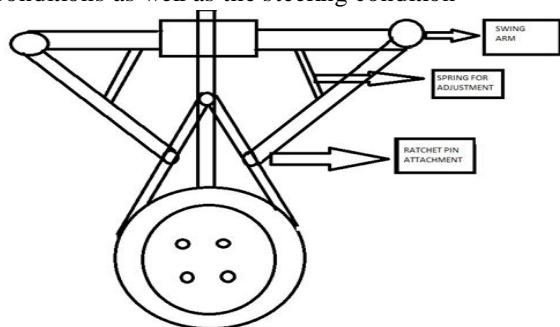


Figure 5.1 Modified Braking system

- Swing Arm is used in the corners for better flexibility and better turning moment capabilities
- Spring support is provided in between the swing arm for better load bearing
- Ratchet pin attachment is the place where the lever pedal adjusts itself in proper position.

6. OBSERVATIONS OF MODIFICATION

After the modification done certain criteria differs from the original braking system there will be a improved braking system

Some of them are advantages of this modification

- No frequent brake shoe changes
- No manual lever adjustment is done
- No need new lever instrumentation
- No need frequent service of brakes

7. CONCLUSION

After these modification is done in the regular braking system a new mechanism is introduced in it which helped in innovating in name of self-adjusting brakes are can be called as self-healing brakes, by this modification the brakes do not retain to original state but the lever is adjusted as it was in the beginning stage of braking pedal.

REFERNCES

- [1] Google www.google.co.in
- [2] Wikipedia
- [3] IJIRT (International Journal of Innovative Research in technology) Brake system in a briefer side
- [4] TJPRC Paper on the braking system and current technology system
- [5] Theory of machines by S.S. Ratan
- [6] Tractor complete nomenclature <https://www.slideshare.net/kathryngraham/tractor-ppt-47543543>
- [7] Design data book
- [8] Braking performance of tractors bus and heavy vehicles <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.893.9846&rep=rep1&type=pdf>
- [9] Research paper on innovation technology in automobile system
- [10] SCIENCE direct Advanced braking system <https://www.sciencedirect.com/>
- [11] Science direct A paper in Development of a prediction model for estimating a tractor on engine torque based on soft computing and lost costsensors <https://www.sciencedirect.com/science/article/pii/S0263224118301490> written by Majid Rajabi Vandechali, Abbas Rohini
- [12] Measurement and evaluation of the quality of the static characteristics of brakes valves for agricultural tractor written by Zbiginew Kaminski