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Use and effectiveness of Hydraulic Retarders

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***Abstract*—Trucks play an important role in the modern life that we live in. They are used extensively to transport goods from a one place to another whether it be the transport of products like biscuits, soaps, etc from factories to retail outlets and supermarkets or the transport of raw materials and critical components for various industries. Thus we can safely say that transport through trucks occupy a good amount of portion in any logistics chain of many goods and products. But trucks are also responsible for many accidents and one of the reasons for them is the failure or reduction in performance of their breaking systems due to continuous or repeated breaking especially when going downhill in hilly areas. Hence Hydraulic Retarders can be a very good system that can be used to avoid these problems and increase safety.**

Keywords—Hydraulic Retarder; Braking; Overheating of Brakes; Increased Safety and Reliability of Trucks;

I. INTRODUCTION

Brakes used in heavy vehicles like trucks are generally disc or drum brakes. These conventional brakes are generally designed to give intermittent and quick braking. Under long and continuous braking for example when going downhill in loaded condition these conventional braking systems tend to heat up. This heat may reduce their braking performance and in some cases can even lead to their failure. Hence to avoid this hydraulic retarders are used to augment and support the conventional braking systems.

Hydraulic Retarder is a mechanical device through which speed of High transport vehicles (HTVs) such as truck can be controlled at some amount. It is a secondary Braking system which helps Primary Braking system in Braking by reducing the speed of vehicle, due to which there is less pressure on Primary braking system which may be drum or disc brakes depending upon the truck. This is especially useful when going downhill in hilly area when the truck is loaded. Hydraulic Retarders serve to slow vehicles or maintain a steady speed while travelling down a hill, and help to prevent the vehicle from " running away" by accelerating down the hill. They are usually used as an additional assistance to slow vehicles, with the final braking done by a conventional friction braking system.

Hydraulic retarders are designed to give continuous and long term braking unlike conventional brakes. Hydraulic retarders are also free from wear and tear since there is no direct friction contacts which are used in drum or disc brakes. They provide the braking effect by offering resistance to the rotation of wheels by converting the kinetic energy of the truck into heat energy of the oil which is then dissipated through the radiator or a heat exchanger provided in the truck.

Because of Hydraulic Retarder the efficiency of Primary conventional braking system increases. Also the conventional braking systems become more reliable and overall they give less maintenance because of less usage. It also enhances the overall safety of Vehicle.

II. CONSTRUCTION AND LAYOUT OF TESTING APPARATUS

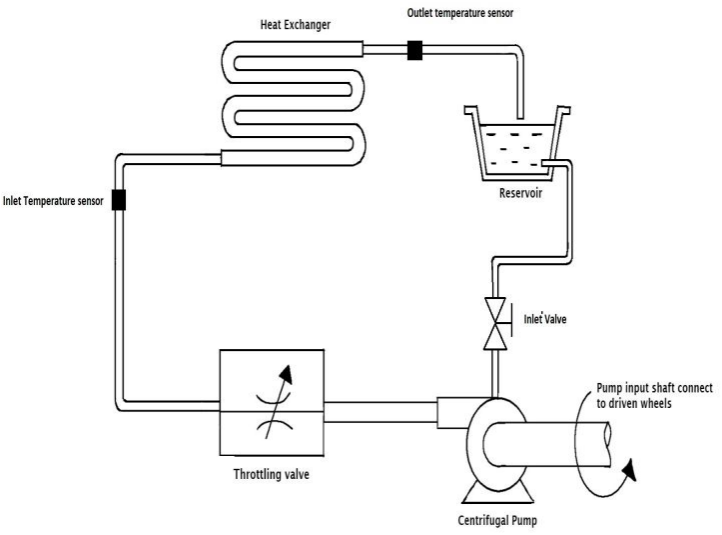

Fig 1 : Simplified layout of testing aparatus

The layout of our testing aparatus is shown as above. We have used a pump of centrifugal type which is coupled to a motor which is used to imitate the wheels of the truck. The

outlet of the pump is connected to the throttling or outlet valve as showed in the layout. It is then connected to the heat exchanger which is used to cool down the oil. The outlet of the heat exchanger is sent back to the reservoir. Between the reservoir and the inlet of the pump an inlet valve is also attached to control the flow.

To measure the rise in temperature of the oil we have placed two temperature sensors. One of them is placed before the heat exchanger and the other is placed after the heat exchanger. This will help us to see the temperature drop across the heat exchanger.

To measure and analyse the braking performance under various settings we need to measure the rpm of the motor. To measure the rpm of the motor a non contact type of tachometer is used. The reflector strip for the tachometer was placed on the motor shaft.

III. SELECTION OF OIL AND EFFECT OF REDUCTION OF SPEED ON OIL

When the Hydraulic retarder is in use it converts the kinetic energy of wheels into heat energy which raises the temperature of the oil. This is because the oil rotates and churns inside the pump casing and the kinetic energy of the oil gets converted to heat energy. Viscosity of the oil plays a major role in this. Higher the viscosity of oil higher is the resistance offered and higher is the heating of the oil. Hence an oil with a higher viscosity is preferred. But too much high viscosity will also cause too much resistance and problems in flow of oil through the system. Therefore, we have used oil which is a blend of 10W30 motor oil and transformer oil which gives the necessary viscosity required for the oil to be used in our system.

Part of heating of the oil is also due to the pressure drop in the valve used for throttling the flow of oil after the pump. This is because the Joule-Thomson coefficient of the oil used is negative and hence it actually heats up during throttling.

Due to all this heating the viscosity of the oil also gets affected. As the temperature of the oil increases its viscosity decreases which ca adversely affect the braking performance of the system. Hence to dissipate all this heat a heat exchanger is used with cooling fans which can be set to turn on when the temperature of oil reaches to a desired temperature using the XH-W3001 temperature controller. Another temperature sensor is also placed at the end of the heat exchanger to measure the drop in temperature of oil.

IV. TESTING AND OBSERVATIONS

All readings were taken after running the system for 1 and half minute for each setting. After recording 1 reading the system was allowed to cool down to ambient temperatures before starting the next test on a different setting. This ensured a proper testing and good readings with minimum effects of previous test on the current test readings.

Initial temperature (Ambient) = 30.8 ^{o}C

Table 1: Effect of valve settings on the RPM of motor and temperature of oil

Sr No	Valve position		RPM of Pump	Temperature	
	Inlet valve	Outlet valve		Inlet of Heat Exchanger	Outlet of Heat Exchanger
1	Closed	Full open	2998	32.8 ^{o}C	30.8 ^{o}C
2	½ Closed	Full open	2848	36.0 ^{o}C	32.2 ^{o}C
3	½ Closed	½ Closed	2805	36.6 ^{o}C	32.5 ^{o}C
4	Full open	Full open	2796	36.9 ^{o}C	33.1 ^{o}C
5	Full open	½ Closed	2764	37.0 ^{o}C	33.1 ^{o}C
6	Full open	Closed	2587	38.1 ^{o}C	33.3 ^{o}C

V. RESULTS

From the above table it is observed the max reduction in speed (2587 rpm) is achieved when the position of the inlet valve is fully open and the outlet valve is closed.

It is also observed that the maximum temperature (38.1 ^{o}C) attained during testing is also at the same position of valves.

The temperature drop across the heat exchanger goes on increasing as the temperature of the oil increases.

VI. CONCLUSION

From the following experiment we can conclude that we get a reduction in speed of the motor indicating breaking effect of the system. But the reduction in speed is subtle and remains pretty constant during the testing duration on a particular valve setting and the readings are in line with the expectations from a hydraulic retarder. Also the temperature of the oil increases indicating the conversion of kinetic energy of the motor into heat energy of the oil which raises its temperature. There is not much difference in the temperature of oil after the heat exchanger in all of the settings indicating the effectiveness of the heat exchanger in maintaining the viscosity of the oil. Hence hydraulic retarders are effective in slowing down the speed and providing continuous and reliable breaking effect.

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