International Journal of Mechanical Engineering and Robotics Research

ISSN 2278 – 0149 www.ijmerr.com
Vol. 4, No. 2, April 2015

Review Article

RETARDER USED AS BRAKING SYSTEM IN HEAVY VEHICLES—A REVIEW

Shyam Narayan Pandey[1]*, Abdul Khaliq[1], Md Zakaullah Zaka[1], Mohd Saad Saleem[1] and Mohd Afzal[1]

*Corresponding Author: Shyam Narayan Pandey, ✉ shyampandey2011@gmail.com

Through this paper an initiative is taken to put focus on a special technique of retarder mechanism which is used in automobile industries. In this technique retarder device is used to augment or replace some of the functionsof primary friction-based braking systems, usually on heavy vehicles. Friction-based braking systems are susceptible to 'brake fade' when usedextensively for continuous periods, which can be dangerous if brakingperformance drops below what is required to stop the vehicle-forinstance if a truck or bus is descending a long decline. For this reason, such heavy vehicles are frequently fitted with a supplementary system that is not friction-based.

Keywords: Retarder, Breaking system, Heavy vehicles

INTRODUCTION

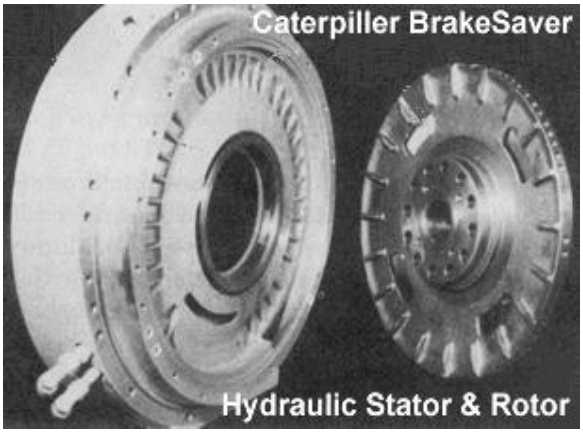
Retarders are not restricted to road motor vehicles, but may also be usedin railway systems. The British prototype Advanced Passenger Train (APT) used hydraulic retarders to allow the high-speed train to stop in the same distance as standard lower

Speed trains, as a pure friction-based system was not viable. Retarders serve to slow vehicles, or maintain a steady speed on declines, and help prevent the vehicle 'runningaway' by accelerating down the decline. They are not usually capable of bringing vehicles to a standstill, as their effectiveness diminishes as vehicle speed

Figure 1: Hydraulic Retarder

[1] Department of Mechanical Engineering, University Polytechnic, Integral University Lucknow, INDIA

Figure 2: Torque Converter, Opened, Interior Similar to a Retarder



lowers. They are usually used as an additional 'assistance' to slow vehicles, with the final braking done by a conventional friction braking system. As the friction brake will beused less, particularly at higher speeds, their service life is increased.

Retarders serve to slow vehicles, or maintain a steady speed on declines, and help prevent the vehicle 'runningaway' by accelerating down the decline. They are not usually capable of bringing vehicles to a standstill, as their effectiveness diminishes as vehicle speed lowers. They are usually used as an additional 'assistance' to slowvehicles, with the final braking done by a conventional friction braking system. As the friction brake will beused less, particularly at higher speeds, their service life is increased.

The Hydraulic Retarder

Hydraulic retarders use the viscous drag forces between dynamic and static vanes in a fluid-filled chamber to achieve retardation. There are several different types which can use standard transmission fluid (gear oil), aseparate oil supply, or water. A simple retarder uses vanes attached to a transmission driveshaft between the clutch and roadwheels. They canalso be driven separately via gears off a driveshaft. The vanes are enclosed in a static chamber with small clearances to the chamber's walls (which will also be vaned), as in an automatic transmission. When retardation is required, fluid (oil or water) is pumped into the chamber, and the viscous drag induced will slow the vehicle. The working fluid will heat, and is usually circulated through a cooling system. The degree of retardation can bevaried by adjusting the fill level of the chamber. Hydraulic retarders are extremely quiet, often inaudible over the sound of a running engine, and are especiallyquiet in operation compared to engine brakes.

The Electric Retarder

The electric retarder uses electromagnetic induction to provide a retardation force. An electric retardation unitcan be placed on an axle, transmission, or driveline and consists of a rotor attached to the axle, transmission, or driveline—and a stator securely attached to the vehicle chassis. There are no contact surfaces between the rotorand stator, and no working fluid. When retardation is required, the electrical windings in the stator receivepower from the vehicle battery, producing a magnetic field for the rotor to move in. This induces eddy currentsin the rotor, which produces an opposing magnetic field to the stator. The opposing magnetic fields slow therotor, and hence the axle, transmission or driveshaft to which it is attached. The rotor incorporates internalvanes (like a ventilated brake disk) to provide its own air cooling, so no load is placed on the vehicle's enginecooling system. The operation of the system is extremely

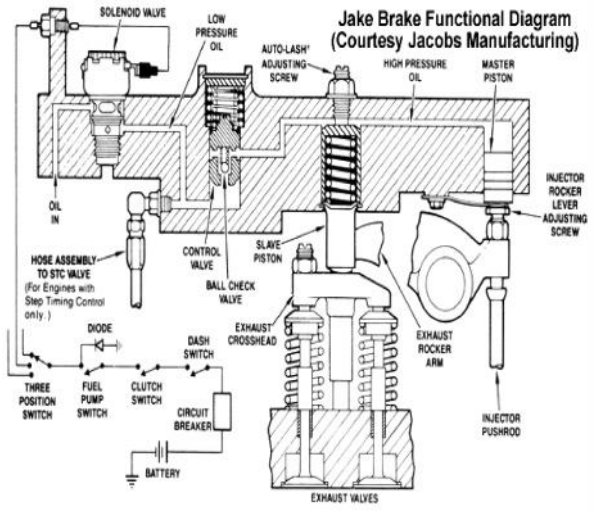
quiet.A hybrid vehicle drivetrain uses electrical retardation to assist the mechanical brakes, while recycling theenergy. The electric traction motor acts as a generator to charge the battery. The power stored in the battery isavailable to help the vehicle accelerate.

Engine Compression Retarders

The engine compression retarder uses the engine's compression stroke to absorb energy from the vehicle's motion. Normally the piston compresses the cylinder air for the next power stroke, and this compression of the cylinder air takes energy. That energy is normally provided by another cylinder which is in its power stroke. The engine compression retarder uses up vehicle motion energy during the compression stroke of each piston because the other cylinders are not producing power during their power stroke time interval. No (or insignificant) engine power is generated, because the throttle must be at the idle position for the retarder to operate. During the retarder mode of operation, when the piston approaches the top of the compression stroke, the retarder system opens the exhaust valves for that piston, which vents the energy which was absorbed from the vehicle's motion. The retarder works by absorbing energy during the compression stroke, and throwing away this energy through the exhaust valves as the piston completes its compression stroke. The most popular engine compression retarder is the Jake Brake. This retarder system is manufactured by the Jacobs Manufacturing Company, and their product is available for Caterpillar, Cummins, Detroit Diesel, and Mack engines, just to name a few.

Refer to the diagram above. The electric signal activates the solenoid valve. The active solenoid valve applies engine oil pressure to the control valve. The engine oil pressure force moves the ported piston of the control valve up until the piston port aligns with the high pressure oil passage to the slave piston. The check ball in the control valve allows the engine oil pressure to fill the slave piston and the master piston voids via the high pressure oil passage. As the cylinder completes its compression stroke, the cylinder injector pushrod rises and lifts the master piston. This forces the oil out from above the master piston into the slave piston. Remember, the check ball in the control valve prevents the high oil pressure from bleeding back into the lower pressure engine oil supply. As the injector pushrod moves upwards, the slave piston pushes down on the exhaust crosshead which opens the exhaust valves. This releases the compressed air which provided the retarder braking action. When the retarder is deactivated, the solenoid valve vents the engine oil pressure, which allows the control valve spring to lower its ported piston, which seals off the high pressure oil passage. To

Figure 3: Engine Compression Retarder



activate the Jake Brake, four requirements must be met, as shown in the diagram above. The dash switch must be on, the clutch must be engaged, the throttle must be at idle, and the driver and/or cruise control must have activated the retarder. Engine RPM must be kept high for the most retarder effect.

Function and Installation of Retarder

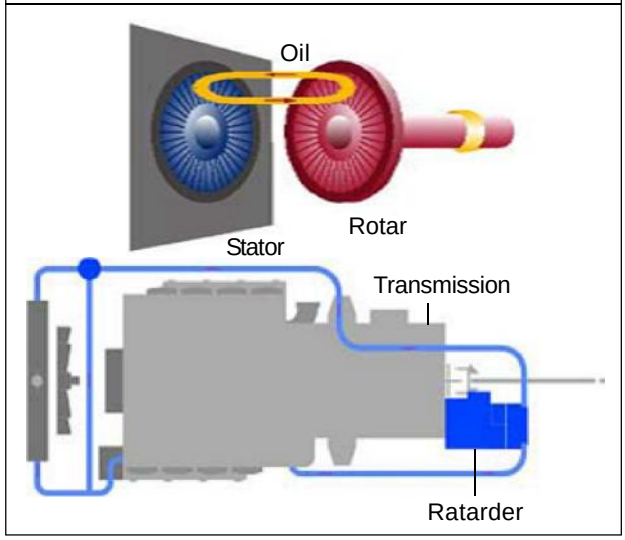
Retarders are highperformance brakes decelerating even heavy vehicles safely and effectively. The retarder braking power is approximately twice the value the vehicle engine power.

The prop shaft driven rotor accelerates the oil being decelerated in the stator. The oil turbulence decelerates the rotor and thus brakes the vehicle. The braking heat generated is being dissipated through the vehicle cooling system.

Offline Installation

- Attached to the transmission
- Prop shaft not modified

Figure 4: Function of Retarder



- Auxiliary power take-offs freely accessible
- Own oil supply system

Inline Installation

- Attached to the transmission
- Own oil supply system
- Perfectly suitable for retrofit

CONCLUSION

There are many retarder options available today. The retarder will normally make your rig a safer rig on the road and will extend your service brake life. There is a lot of arguing amongst drivers about whether or not to use the jake brake during shifting. During the shifting double clutch, the conditions are correct for jake brake activation. If your gear shifts are close together, then the jake brake will fight you on the engine RPM match while shifting.

However, if the gear shift result in large RPM drops, or if the shift is on a steep grade which results in rapid truck speed loss, then use of the jake brake may very well help you to grab that next gear quicker. In this situation, the truck speed is falling rapidly, and the engine RPMs are falling normally, so during the double clutch, the engine RPMs are yanked lower by the jake brake. This might be helpful to get that next gear in place during a slow and steep grade climb.

REFERENCES

1. http://www.zafr.com/trucktcom/retarder.htm.
2. JakeBrake.com (http://www.jakebrake.com/), “A Manufacturer of Engine Brakes”.

3. Joachim Horne, Joachim Bambergera, Peter Michaud *et al.* (2003), "Flatness-Based Clutch Control for Automated Manual Transmission [J]", *Control Engineering Practice*, pp. 1353-1359.
4. Voithturbo.com(http://www.voithturbo.com/retarder_e.htm), A Manufacturer of Oil- and Water–Base Hydraulic Retarders.
5. Wang J (2008), "Study on Digital Adaptive Shift Control Strategy", Beijing Institute of Technology, pp. 58-62, Beijing.