Technical Torque #23

The Development of the Braking System; Part 3

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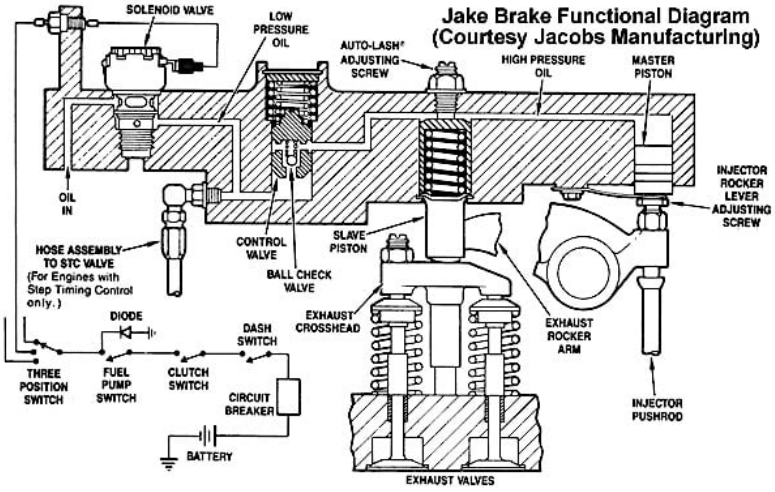
In Part 3 we will look at the development of alternative brake operating and advanced control systems.

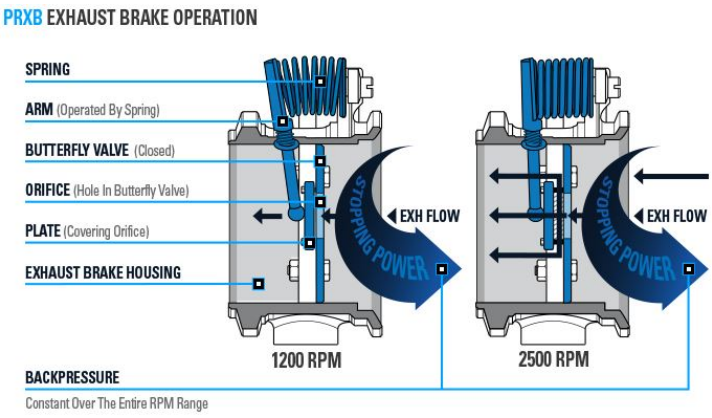
Additional braking systems

Jacobs (Jake) Brake



The Jake brake utilises the compression of the engine to provide deceleration and was first developed by Clessie Lyle Cummins in the first quarter of the twentieth century and is manufactured by the Jacobs Vehicle Systems company. While other manufacturers make similar systems for their own engines the Jacobs brand has the greatest market share. While providing significantly greater retardation than other auxiliary brake systems, Jake brakes do have a downside, their initial cost is high, due to their complexity and expense so they are not considered a retrofit option. Also they are considered anti-social due to their loud and irritating noise when in operation so their use is banned or seriously discouraged in many jurisdictions, especially in built up areas.

Exhaust Brake



Exhaust brakes operate on the other side of the combustion cycle than the Jake brake so they are significantly quieter, no louder that the standard exhaust. When engaged they operate by closing a butterfly valve in the exhaust after the turbocharger creating back pressure in the exhaust system and slowing engine rotation by trapping exhaust gases causing the pistons to push against increased resistance when forcing combustion gases out. While still effective, exhaust brakes are not as effective as the Jake brake but they are much quieter, have lower maintenance costs and are a simple aftermarket option.

Energy Recovery

The development of hybrid and electric vehicles has opened another avenue of retardation, energy recovery. These systems are becoming an increasingly serious supplement, even alternative, to conventional (wheel) brakes. These systems operate by switching the electric motor into a generator once the power to the motor is interrupted meaning the motor becomes a drag on the system changing the kinetic energy of movement back to electrical energy and recharging the battery giving retardation in a similar manner to how compression braking works on an ICE system. Of course, at

this stage, energy recovery will not replace conventional foundation braking systems nor will it provide sufficient deceleration during hard braking. However, it can easily reduce the wear and tear on foundation braking systems during easy, everyday driving.

Anti-lock brakes

The anti-lock brake system, better known as ABS, was developed to assist and enhance braking systems by preventing the brakes from locking up while in use, therefore maintaining control of the vehicle. ABS works by using sensors to read an annular ring at the wheel end to sense when lock-up is about to occur and initiating a system of valves to reduce the braking force of a brake on the affected wheel. The system revolutionised the way brakes function and is useful in providing more control for the driver. Prior to the advent of ABS, to maintain control and prevent a vehicle from skidding, the driver would have to employ a system known as 'Cadence Braking' where they would 'feel' lock-up starting and release the brake then immediately apply it again until they felt the onset of lock-up again and released the brake, a skill not all drivers possessed. This process would continue until the vehicle had slowed down to the desired speed. It should be noted that ABS does not shorten the braking distance but it does allow the driver to maintain control of the slowing vehicle enabling them to manoeuvre the braking vehicle, something that is not possible if the wheels are locked and skidding.

ESC

The most recent advance in braking that directly impacts on the foundation brake of the vehicle is ESC, Electronic Stability Control. This works by using wheel sensors to detect if an individual wheel is about to skid or lose traction and either releases the brake on the wheel that has lost traction or, if the loss of traction occurs without the brakes being applied, for example, understeer or oversteer when entering a corner too fast, the system will apply the brakes to the wheel that have not lost traction and bring the vehicle back under control. The ESC system is able to react quickly enough to bring an errant air braked vehicle back under control because its control is electronic. Instead of sending air through the system by way of operation of the treadle valve the system is fully charged and the signal is sent electronically, almost instantaneously, to the wheel chosen by the system for intervention to either apply or release the brake. The system is integrated into the vehicle's ECU and, for the driven wheels, can also apply or release engine torque as required. ESC means the vehicle's braking system is fully integrated with all the vehicle's other electronic systems through the ECU which has the capability to control many of the vehicle's functions.

Brake Assistance

The advent of electronics in vehicles and with them having their systems monitored and controlled by on board 'brains' through their Electronic Control Systems (ECU), has opened the door for many automatic or autonomous braking systems utilising the foundation brakes, such as;

- Emergency Brake Assist (EBA), where the driver is warned of upcoming or potential hazards and, if the driver does not react quickly enough, applies the brakes to avoid or prevent a crash.
- Active Brake Assist (ABA), that uses a combination of cameras and radar to detect 'threats' such as stationary or moving objects, including pedestrians, that may be impacted by the vehicle, will both warn the driver and apply the brakes.
- Autonomous Emergency Braking (AEB), where the system monitors vehicle speed and scans the environment for potential 'threats', taking automatic action to prevent harm by applying the brakes while informing the driver of impending danger.

Manufacturers all have their own versions of these systems with a multiplicity of acronyms but they are all designed to achieve one thing, improved safety. They do this by reacting to threats quicker and more consistently that a human operator.