

# Exhaust Braking System-Review Paper

R Palanisamy<sup>1</sup>, M Veeramani<sup>2</sup>, T Jaganathan<sup>3</sup>, M Vasanth<sup>4</sup>, D Prakash<sup>5</sup>

<sup>1</sup> Assistant Professor, Mechanical Department, Veltech, Tamilnadu

<sup>2,3,4,5</sup> Student, Mechanical Engineering, Veltech, Tamilnadu

**Abstract-** One of the most important components of the vehicle is the brakes. The Brake is an essential feature in order to retard and stop the vehicle within minimum possible time. In heavy vehicles apart from the conventional frictional brakes used, some systems are used to aid the braking process and increases the efficiency of braking such as exhaust brakes. The function of an exhaust brake is to aid in slowing down vehicles running with diesel engines without the use of the wheel brakes. This paper tells us about how the exhaust braking system is used in the vehicles, their major components and their pros and cons.

**Index Terms-** Exhaust Brake, Butterfly Valve, Two Stage Pressure Control, Turbo Charged Exhaust Brakes

## 1. INTRODUCTION OF EXHAUST BRAKES

While slowing down the vehicle, when the throttle is released, the vacuum pressure is not created in the diesel engine while running. Because of this reason, exhaust brake has been implemented by the manufacturers. So wear and tear on the conventional brakes is reduced. And it makes towing heavy loads to a bit safer. The diesel engine is slowed down by the exhaust brakes by blocking the exhaust gases from the engine. This causes the compression of exhaust gases in the exhaust manifold and also in the cylinder. Because of this reason, the supply of fuel is stopped and the engine acts backward so the pressure called back pressure is created in the engine. Due to this back pressure the negative torque generated which is proportional to that pressure of the engine.

### 1.1 What is an Exhaust Brake?

An exhaust brake is a mechanical device which mainly creates a major restriction in the exhaust manifold, and it creates the back pressure in the engine cylinder. So the engine will attain the reduction of speed and gives the support to the

conventional braking system. In most of the cases, an exhaust brake is so effective that it can slow down a heavily loaded vehicle on a downgrade without ever applying the vehicle's service brakes. Nowadays the exhaust brakes are produced by various manufacturers. These brakes can vary in design among one another, but it will only operate as described above. Exhaust pressure modulation is the most advanced brake which controls the back pressure and which in turn improve the performance of the braking system.



Figure 1 Exhaust brake

### 1.2 why do we need this?

In the current scenario, the technology has been growing day by day. In that the highways are developed in long ways and speed of the vehicles is increased and also the capacity of the vehicles is increased. Due to these the safety of the people are reduced.

The primary brake system of the vehicle is easily damaged by the overheating due to an increase of the braking load frequently. This results from the brake failure.

In spite of the driver needs to drive that in various ways like hills, mountains, cities, he needs to use the primary braking system. This causes the reduction of average speed and the operating cost is also affected.

Due to improper braking systems, various road accidents take place in the heavy load vehicles. So we have to reduce the effects of braking in this kind of reasons. By giving support to the conventional brakes, systems like a Jake brake, retarders, and exhaust brakes etc., are used to support the primary brake system.

### 1.3 Jake brake

A Jake brake is one of the supporting brakes in the braking system. The principle of this brake works by the pressure of hydraulic energy. At the end of the compression stroke, this brake opens the exhaust system and sent out all the compressed air by that pressure. Due to this reason, the Jake brake is noisy in operation.

The working of Jake brake occurs by eliminating the compressed air "rebound" in the expansion stroke. In this braking pumping, loss occurs due to air compression.

Pumping loss of piston make the power stroke act reversely. At the time both inlet and exhaust valves.

### 1.4 Jake Brake vs Exhaust Brake

Everyone thought that gasoline engine and diesel engine uses engine braking in the vehicles. But actually, petrol engines only use engine braking i.e., Jake brakes and the diesel engines used Exhaust brake system. They both have different working methods. The operation of both of them is different.

### 1.5 Maximum pressure of exhaust brake

Braking force is created by leaving the compressed air in the cylinders. But when we see the exhaust gases are blocked in the path of exhaust brake which created back pressure. This pressure is used to slow down the engine

This kind of supporting braking systems are used in the multi-axle loads' vehicle on a downgrade without ever applying the vehicle's service brakes.

The bottlenecking effect is taken in the cylinder by the exhaust flow. In the exhaust brake, the pressure is built upstream rapidly in the exhaust system. Based on the speed of the engine maximum working pressure can be reached up to 60 PSI. That maximum working pressure has the restriction based on the design.

The new ideas can be raised to increase the back-pressure of the exhaust by different effects which

lead to high torque in the flywheel. So more braking power can be reached. The unit of braking effectiveness is calculated by using the units of power. And the maximum power output is about 60% to 80%. The downshifting of vehicle can increase the performance.

## 2. MAIN COMPONENTS OF EXHAUST BRAKING SYSTEM

### 2.1 Pedal-operated Butterfly Valve

The acrylic material is used to make the butterfly valve. The shape of the valve is circular which has three peripheral cuts. The exhaust pipe cannot be blocked by those circular cuts by that circular cross section. The holes provided are very helpful otherwise, the engine would be stopped completely.

The hydraulic linkages are used to actuate the butterfly valve. The butterfly valve is connected to the hydraulic pressure pump. The operation of the butterfly valve is controlled by the pump.

### 2.2 ARIS Actuator Valve

The butterfly valve is acted by the pneumatic or hydraulic actuators. The pressure of the exhaust is high. So it is difficult to use these type of the actuators. So the ARIS type of valve actuator is used instead of those inefficient valves. It provides the sufficient valve operating power.

### 2.3 Two stage pressure control

Increasing the back pressure of the engine by the butterfly valve will also be done in two stages which means two valves can be operated. There is a lot of advantages while using it instead of using single valves. So the efficient working can be achieved by this valve and also it increases the life of the valves by reducing the failure of valves.

This type of arrangement is widely used in the heavy-duty trucks due to overload in the vehicles. In these vehicles, high force is needed to balance high back pressure to reduce the speed of the engine. For this purpose, the two valve arrangement gives a good support.

## 3. WORKING OF EXHAUST BRAKE

When the driver applies the brakes, the pressure in cylinder gets reduced. Then the path of exhaust gases are restricted because of the valve closes the way.

Then the back pressure is created while the butterfly valve maintains the same perpendicular position on the exhaust manifold. There are holes provided on the butterfly valve so there is the little way to be provided on the exhaust pipe instead of full blockage. So the effect of high pressure can be neglected by this hole.

When the driver releases the brakes, the exhaust gases are passed into the exhaust pipe. Because the butterfly valve has opened and frees the passage. At that time the valve maintains the parallel position so the exhaust gases flow freely out of the engine by the exhaust pipe. So the pressure of the engine gets released. Thus the speed of the engine is increased.

For this valve operation, the simple linkage is used instead of cylinder pressure mechanism. The actual arrangement is given to the elastic rubber with the brake pedal. Thus the acting like opening and closing of the butterfly valve is easily handled.

#### *Turbocharged Exhaust Brakes*

A turbocharger is a device which is used to increase the power output by decreasing the fuel consumption. There is a lot of significance on turbocharger with the exhaust brake in diesel engines. When the exhaust manifold is closed by the closing of butterfly valve, there is no emission take place. So that the blades of the turbine of the turbocharger cannot be worked. The turbine blade has the blocking effect. This blocking effect reduces the intake pressure in the diesel engine. So intake of air decreases in the engine then the fuel consumption also decreased. Then it also reduces the speed of the engine.



Figure 1 Exhaust brake & turbo assembly

#### 4. WHAT BENEFITS DO THEY BRING?

##### 4.1. Slowing down the vehicle

The exhaust path is closed by this braking method so the path of exhaust gases to exhaust pipe is blocked. Due to this, inside the exhaust manifold, the back

pressure is created and also in the cylinders. Because of this engine acts reversely. Finally, the speed of the vehicle is slowed down.

##### 4.2. Reducing the wear and tear on the regular brakes.

When the vehicle moves at a low speed, the exhaust brake should be used instead of regular brakes. So the wear and tear of the regular brake can be reduced.

##### 4.3.Reduces overheating

The main advantage of this brake is taking the effects of the regular brake and then it avoids the overheating of the regular brakes. While moving in the downhill areas it becomes very useful.

##### 4.4. Prevent a vehicle while moving downhill to run too fast

The exhaust brake can be very helpful when the vehicle moves too fast in the hills. So the accidents can be avoided.

##### 4.5. Maintaining silent

The vehicle's primary braking system is the important system. But it has a major problem with the noise when applied. But the exhaust brakes are completely different the primary brake. Because it maintains silent while operating.

##### 4.6. Increase the life of normal brakes

Without using the exhaust brake, the normal brake needs more effort to stop the vehicle. At the same time with the use of exhaust brake, the efforts are reduced in the main brake system. So the life of the main brake system is increased.

##### 4.7. Effectiveness, noise reduction and can be installed on all vehicles

one of the types of engine brake, a compression brake makes much noise during operation. But the exhaust brakes will not produce such noise during operation. So everyone in this field prefers to use the exhaust brakes. It can also increase the effectiveness of braking system Since it is used to reduce the braking effort, it can be suitable for all the vehicles. Especially the heavy loaded vehicles are more suitable one to use.

#### 5. CONCLUSION

The road hazards related to heavy goods vehicles are partly due to inefficient brake systems, or the failure of brakes. This can be minimized by the use of exhaust brakes thus it increases the brake efficiency and life of the conventional friction brakes. Once the exhaust brakes are installed, they can make a vehicle safer and more secure on the road and they minimize the likelihood of putting the vehicle in accidental situations.

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