PREFACE

*‘Practical knowledge leads a man to perfection’*

In the present scenario of neck-to-neck competition in the industry, one has not only to survive but also leave other far behind in race to succeed. For this one needs to have profound theoretical knowledge as well as sound practical aspects which can be assimilated easily and applied into practice on the technical field.

With the help of this analytical report, we have analyzed the various aspects of an automobile engine and its features. In addition the project report would serve as a good reference for the practicing engineers and associated workers.

TABLE OF CONTENTS

S.No. Particulars Page No.

1. Brakes-Introduction, Types 1

2. Mechanical Braking System 2

3. Engine Braking Mechanism 4

4. Exhaust Braking System 5

5. Overall Description 7

6. Project Description 8

7. Methodology 9

8. Pictorial Progress 10

9. Conclusion 12

10. Refrences 13

BRAKES

A brake is a device which inhibits motion. Its opposite component is a [clutch](http://en.wikipedia.org/wiki/Clutch). The rest of this article is dedicated to various types of vehicular brakes.

INTRODUCTION

Most commonly brakes use [friction](http://en.wikipedia.org/wiki/Friction) to convert [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy) into [heat](http://en.wikipedia.org/wiki/Heat), though other methods of energy conversion may be employed. For example [regenerative braking](http://en.wikipedia.org/wiki/Regenerative_braking) converts much of the energy to [electrical energy](http://en.wikipedia.org/wiki/Electrical_energy), which may be stored for later use. Other methods convert [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy) into [potential energy](http://en.wikipedia.org/wiki/Potential_energy) in such stored forms as [pressurized air](http://en.wikipedia.org/wiki/Compressed_air_energy_storage) or pressurized oil. Still other braking methods even transform [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy) into different forms, for example by transferring the energy to a rotating flywheel.

Brakes are generally applied to rotating axles or wheels, but may also take other forms such as the surface of a moving fluid. Some vehicles use a combination of braking mechanisms, such as drag racing cars with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps raised into the air during landing.

[Friction brakes](http://en.wikipedia.org/wiki/Vehicle_brake#Friction_brake) on [automobiles](http://en.wikipedia.org/wiki/Automobile) store braking heat in the [drum brake](http://en.wikipedia.org/wiki/Drum_brake) or [disc brake](http://en.wikipedia.org/wiki/Disc_brake) while braking then conduct it to the [air](http://en.wikipedia.org/wiki/Air) gradually. When traveling downhill some vehicles can [use their engines to brake](http://en.wikipedia.org/wiki/Engine_braking).

FUNCTION OF BRAKES

1. To stop the slowdown the vehicle in the shortest possible distance in emergencies.

2. To control the vehicle to be retained when descending a hill.

The first function calls for the brakes which can apply large braking torques to the brake drums, while the second calls for brakes that can dissipate large quantities of heat without large temperature rises.

TYPES OF BRAKING SYSTEM

1. Mechanical Braking System
2. Engine Braking
3. Exhaust Braking

MECHANICAL BRAKING SYSTEM

Mechanical brakes all act by generating frictional forces as two surfaces rub against each other. The stopping power or capacity of a brake depends largely on the surface area of frictional surfaces as well as on the actuation force applied. The friction and wear encountered by the working surfaces are severe. Thus, the durability of a brake or service life between maintenance depends heavily on the type of material used to line the shoe or pad.

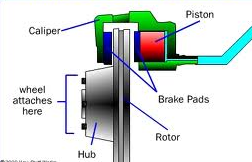
Mechanical brakes are assemblies consisting of mechanical elements for the slowing or stopping of shafts in equipment drives. They use levers or linkages to transmit force from one point to another. Braking slows or stops the movement of the coupled shafts. There are several types of mechanical brakes. Band brakes, the simplest brake configuration, have a metal band lined with heat and wear resistant friction material. Drum brakes, which are commonly used on automobile rear wheels, work when shoes press against a spinning surface called a drum. Disc brakes are constructed of brake pads, a caliper, and a rotor. During operation, the brake pads are squeezed

against the rotor. Cone brakes are made with a cup and a cone, which is lined with heat and wear resistant material.  During actuation, the cone is pressed against the mating cup surface.

TYPES OF MECHANICAL BRAKING

DISC BRAKE

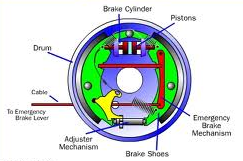
The disc brake is a device for slowing or stopping the rotation of a wheel while it is in motion. A brake disc is usually made of cast iron, but may in some cases be made of composites such as reinforced carbon-carbon or ceramic-matrix composites. This is connected to the wheel and/or the axle. To stop the wheel, friction material in the form of brake pads (mounted on a device called a brake caliper) is forced hydraulically, [pneumatically](http://en.wikipedia.org/wiki/Pneumatics) or [electromagnetically](http://en.wikipedia.org/wiki/Electromagnet) against both sides of the disc. [Friction](http://en.wikipedia.org/wiki/Friction) causes the disc and attached wheel to slow or stop. Brakes convert motion to heat, and if the brakes get too hot, they become less effective, a phenomenon known as [brake fade](http://en.wikipedia.org/wiki/Brake_fade).



DRUM BRAKES

A drum brake is a [brake](http://en.wikipedia.org/wiki/Brake) in which the [friction](http://en.wikipedia.org/wiki/Friction) is caused by a set of [shoes](http://en.wikipedia.org/wiki/Brake_shoe) or [pads](http://en.wikipedia.org/wiki/Brake_pad) that press againt a rotating drum-shaped part called a brake drum.

The term "drum brake" usually means a brake in which shoes press on the [inner surface](http://en.wikipedia.org/wiki/Brake_lining) of the drum. When shoes press on the outside of the drum, it is usually called a[clasp brake](http://en.wikipedia.org/wiki/Railway_brake). Where the drum is pinched between two shoes, similar to a conventional [disk brake](http://en.wikipedia.org/wiki/Disk_brake), it is sometimes called a "pinch drum brake", although such brakes are relatively rare. A related type of brake uses a flexible belt or "band" wrapping around the outside of a drum, called a [band brake](http://en.wikipedia.org/wiki/Band_brake).

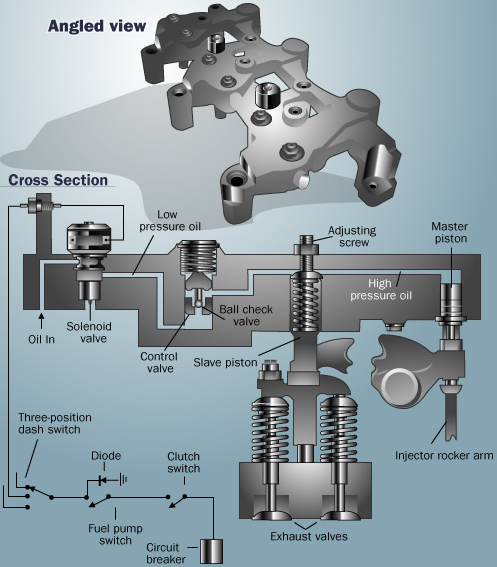


ENGINE BRAKING

A compression engine brake is a device that can convert a diesel engine into an air compressor, a power absorbing device. These devices are used in trucking applications to provide a means for retarding the vehicle, supplementing the normal vehicle braking system. The retarding operation is under full control of the vehicle operator and can be used simultaneously with the normal service brakes. Engine brakes can be installed at any time to a new or used vehicle for most applications.

In normal operation, a diesel engine provides power through compression of air in a cylinder into which diesel fuel is injected and ignited. When fuel is cut off by releasing the throttle, the engine produces no power. It does, however, continue to compress air during the compression stroke of the piston. The "work" required to compress this air is obtained from the inertia of the vehicle. Upon reaching the top of the compression stroke, compressed air forces the piston down, canceling out all of the "work" performed on the upward stroke. The result is that power is returned to the vehicle via the crankshaft during the expansion stroke. The only retardation offered by an engine without an engine brake is friction from the moving parts.

Operation of the compression brake alters what happens at the top of the compression stroke. When the piston reaches the top of its stroke the exhaust valves are opened, allowing compressed air to exhaust to the atmosphere. Because energy stored in the compressed air is no longer retained in the cylinder, no power producing "work" is returned to the engine during the downward stroke. The vacuum that is subsequently created when the piston moves down again also adds to the immense amounts of braking force. A 565 hp (421 kW) diesel engine can produce up to 600 hp (450 kW) of braking power.



Layout Of Engine Braking Mechanism

EXHAUST BRAKING MECHANISM

An exhaust brake works by restricting the flow of exhaust gases through the engine

Heavy goods vehicles can often require increased braking, in situations where friction brakes could overheat and fail. This is achieved by using an exhaust brake.

It achieves this by closing a butterfly valve located in the exhaust manifold. This maintains high pressures in the exhaust manifold, and the engine cylinders, which in turn, acts as a brake against the engine rotating. This then slows the road wheels through the transmission, or power train.

DESCRIPTION

This invention relates to an exhaust braking system for an internal combustion engine and in particular, although not exclusively, to such a braking system for a diesel engine.

It is well known that an exhaust braking system for an internal combustion engine effects secondary braking working in tandem with the normal friction brakes of a large commercial vehicle. A known exhaust brake comprises a housing with a through passage which is arranged to be closed by a blade when braking is required. The exhaust brake generates a back pressure within the exhaust passage which lifts the exhaust valve from its seating and imparts a back pressure within the cylinder on the piston crown to cause retardation or braking of the rotational speed of the engine and subsequently the vehicle. The amount of back pressure is predominantly dependent upon the force exerted by the engine valve spring, since the back pressure must be sufficient to lift the valve from its seat. It will be appreciated that on the engine induction stroke the piston cylinder is vented to the atmosphere through the induction manifold by opening the induction valve so that the exhaust gas pressure within the cylinder is released.

Engine manufacturer's have become concerned that when exhaust brakes are used with internal combustion engines the back pressure created by the exhaust brake when lifting the exhaust valves from the valve seats will create a situation in which a piston upon its return to top dead centre will strike the head of the exhaust valve. To avoid this happening, it is common practice for a hole of a predetermined size to be provided through the blade of the exhaust brake so as to limit the back pressure in the exhaust system. It is desirable to increase the efficiency of the exhaust brake so as to produce greater retardation braking of the engine and one way of achieving such an improvement is to increase the back pressure created by the exhaust brake. However, an increase in the back pressure will only serve to hold the exhaust valve open increasing the likelihood of the piston striking the exhaust valve.

Several ways have been tried to overcome this problem, one of which is to increase the strength of the valve springs, but this is often undesirable since the valve operating mechanisms are then subjected to undue wear.

Therefore, there is a need to provide a braking system for an internal combustion engine in which the above disadvantages are overcome.

According to one aspect of the present invention there is provided an exhaust braking system for an internal combustion engine having an inlet valve and an exhaust valve, the system comprising an induction valve arranged to be connected in an induction passage to the inlet valve, an exhaust brake arranged to be connected in an exhaust system connected with an exhaust valve, actuator means connected in a fluid circuit with the induction valve and exhaust brake for operating the induction valve and exhaust brake to close the induction passage and exhaust system when the rotational speed of the engine is to be retarded, timing means connected with the induction valve and exhaust brake for ensuring the exhaust brake is closed no later than the closing of the

induction valve, a non-return valve arranged to be connected in the induction passage between the induction valve and the inlet valve for facilitating an increase in pressure within a piston cylinder of the engine to increase the engine retardation, and pressure relief means arranged to be connected in the induction passage or exhaust system for controlling maximum pressure of the braking system.

The timing means preferably comprises a pair of tubes of differing internal diameters, the tube of larger internal diameter having one end thereof connectible to the exhaust brake, and the tube of smaller internal diameter having one end thereof connectible to the induction valve, the opposing ends of the tubes being connected to the actuator means.

The actuator means is preferably a manually operative foot valve which is conveniently connected with the brake pedal of a commercial road vehicle, for example. Alternatively, the valve can be operated independently or may be coupled to the accelerator pedal.

According to another aspect of the present invention there is provided a method of operating an exhaust brake system for an internal combustion engine having a inlet valve and exhaust valve, the method comprising actuating an induction valve arranged to be connected in an induction passage to the inlet valve, actuating an exhaust brake arranged to be connected in an exhaust system connected with the exhaust valve, operating actuator means connected in a fluid circuit with the induction valve and exhaust brake to initiate actuation of the induction valve and exhaust brake through the intermediary of timing means connected with the induction valve and exhaust brake for ensuring the exhaust brake is closed no later than the closing of the induction valve to close the induction passage and exhaust system when the rotational speed of the engine is to be retarded, introducing air into the induction passage through a non-return valve connected in the passage between the induction valve and the inlet valve to facilitate an increase in pressure within the piston cylinder of the engine to increase engine retardation, and controlling the maximum pressure of the braking system by venting the system through pressure relief means arranged to be connected in the induction passage or exhaust system.

OVERALL DESCRIPTION.

FUNCTION

The function of an exhaust brake is to aid in slowing down [vehicles](http://www.ehow.com/cars/) with diesel engines without the use of the wheel brakes. Some of these brakes work automatically whenever the driver takes his foot off the accelerator, and some are manually controlled via a switch, or both. Different settings allow the driver to control how the brake is applied.

FEATURES

Exhaust brakes feature a "doorway" which closes when the vehicle is rolling and the accelerator is not being used. When in the closed position, these brakes drastically restrict the flow of exhaust gasses, thus increasing the back pressure inside the engine, which ultimately slows the vehicle down. Most also feature a switch or other control inside the cab, which can be set to either activate the second the driver is off the accelerator pedal, or be activated manually in downhill towing situations only.

BENEFITS

The biggest benefit of the exhaust brake is that they add slowing power to the regular brakes, preventing them from heating up and glazing, which dramatically decreases their effectiveness.

When towing heavy loads, these brakes can save lives. These brakes do not damage the engines, and therefore they can be used over and over safely.

CONSIDERATIONS

If you have a pickup truck that regularly sees heavy payload duty or fifth-wheel trailer action, an exhaust brake can greatly help with stopping power. Tractor-trailer trucks have used similar braking systems for years, and now it is being offered to the general public by companies such as Jacobs and Banks.

CAUTION

While an exhaust brake can significantly increase slowing and stopping duties, it is by no means a primary braking system. Also, check local ordinances regarding these brakes, because some can create substantial noise and may be illegal. An exhaust brake is not the same as the Jake Brakes used on semi-trucks, but is similar in idea. Some exhaust brakes may lack power at lower RPMs as well, and are mostly used in full-speed applications.

PROJECT DESCRIPTION

We purchased a Crompton Greaves single cylinder diesel engine for our project.

Also we borrowed a Butterfly Valve used in mini trucks for the exhaust braking system and attached it to the engine’s exhaust.



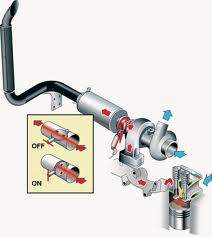
**The Closed Butterfly Valve**

We took a Solenoid Switch to operate the butterfly valve opening and closing in order to apply the exhaust brakes while engine on running condition.



**The system being welded together**

METHODOLOGY



Exhaust Braking Mechanism Layout



The Butterfly Valve Type Construction

PICTORIAL PROGRESS



**Butterfly Valve Open – Exhaust Brakes not applied**



**Butterfly Valve Close – Exhaust Brakes applied**



**Our Project showing Exhaust Brake System**

CONCLUSION

Applying the basic concepts of I.C. Engines into use combined with our knowledge for the systems, we have successfully created a system that displays the Exhaust Braking capabilities and which can also be applied to industrial use.

This project has helped us in ways to develop ourselves in the field of Automobile Engineering. We have gained knowledge in our practical approach towards this project that is needed for the industrial aspects of engineering.

REFERENCE

* Automobile Engineering- N.K.Giri
* Automobile Engineering- R.B. Gupta
* www.tecbrakes.com
* [www.freepatenstonline.com](http://www.freepatenstonline.com)
* www.google.com
* www.engineperformancecenter.com