Unit 4

Introduction:

Cylinder block:

Cylinder is made by high grade cast iron because it is in direct contact of combustion gases. Cast iron has high compressive strength to handle the pressure and temperature. It is made by casting and usually cast in one piece.

Cylinder head:

The main function of cylinder head is to seal the cylinder and it should be light in weight. So cylinder head is usually made by cast iron or aluminum. It is made by casting or forging and usually in one piece.

Piston:

Piston is prime mover in engine so it should be light. It is in direct contact with combustion temperature and pressure so it should has high strength to handle this

pressure. So generally piston is made by cast iron but sometime it is made by aluminum alloy. Usually it is made by casting.

Piston ring:

Piston ring is usually made by fine grain of cast iron which has high elasticity and it is not affected by the working pressure. Sometime piston rings are made by alloy spring steel. It is made by forging.

Connecting rod:

Connecting rod transmits the power to crankshaft. It should have high strength. So it is made by alloy steel but in small engine it is made by aluminum to achieve lighter weight. It is made by forging.

Inlet valve and Exhaust valve:

Inlet valve admits the air and fuel into the cylinder. It is usually made by silicon chrome steel with about 3% carbon. It is made by forging.

Exhaust valve discharge the exhaust gases. It is made by austenitic steal. It is also made by forging.

Crankshaft:

Crankshaft converts the reciprocating motion of piston into rotary motion. It should have high tensile strength. So the crankshaft made by high tensile steel or sometime by cast iron. It is usually made by forging.

Piston Pin:

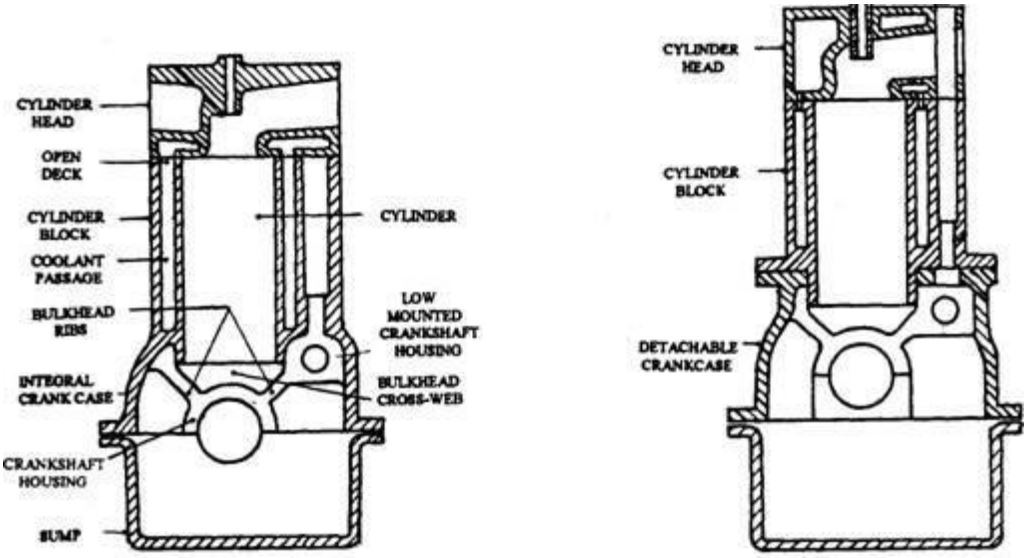
Piston pin is made by hardened steel so it can support and allow to connecting rod to swivel. It is usually made by forging.

Cylinder-block construction

In most engines, the cylinders, cylinder block and crankcase are all cast together. This is known as mono-block construction, as distinct from engines that have their cylinders as separate parts. This is the case with air-cooled engines where the cylinders are made separately to the crankcase.

Mono-block engines with cast-iron blocks have the cylinders bored directly in the cast iron casting. Cast iron is a suitable material for cylinders because it wears well and resists the effects of heat. Cylinder walls can be plated with chromium, which is very resistant to wear, although this is not common for passenger car engines.

The main functions of the cylinder block are: Maintaining the engine's stability and lubrication while withstanding a variety of temperatures and loads. Transferring oil to all parts of the engine, lubricating all the critical components, via a number of oil galleries.



Function Of Cylinder Head

In an internal combustion engine, the cylinder head (often informally abbreviated to just head) sits above the cylinders on top of the cylinder block. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a head gasket. In most engines, the head also provides space for the passages that feed air and fuel to the cylinder, and that allow the exhaust to escape. The head can also be a place to mount the valves, spark plugs, and fuel injectors.

The function of cylinder head is to seal cylinder, form combustion space with piston, and bear the action of high temperature and high pressure gas. The cylinder head best mechanical load caused by the gas force and fastening the cylinder bolt, and also bears the high heat load because of the contact with the high temperature gas. In order to ensure the good sealing of the cylinder, the cylinder head can neither be damaged nor deformed.

Construction Of Cylinder Head

Cylinder head construction defining a hemispheric combustion chamber which includes a guide wall provided to impart swirl to the incoming air-fuel mixture. The guide wall facing the intake port defined by the cylinder head construction and generally parallel to the line of action of an intake valve provided in the intake port has a height greater than the maximum lift of the intake valve, and decreases in width in the direction of opening of the intake valve. In addition, the size of the area and the position of the guide wall relative to the intake port and the intake valve are maintained in specific ranges, and thus the construction not only permits efficient ignition of a lean air-fuel mixture, but at the same time causes only a slight drop in engine performance.

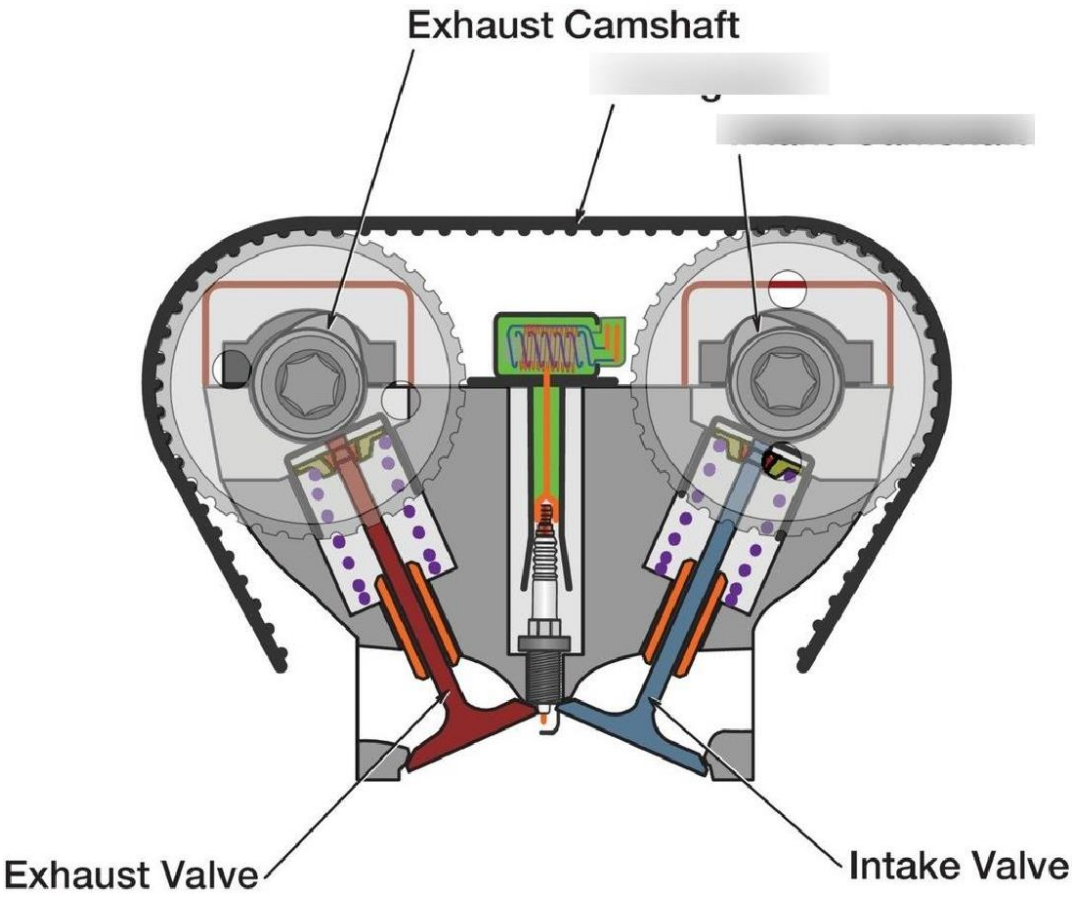
Articulated connecting rod

The plain connecting rod is most common in current automotive practice. It allows addition of bearings of a different material type than the connecting rod. An angle split connecting rod allows it to be removed through the top of the engine, which helps rebuild of engines while the cylinder block is still in the vehicle. This is common in over the highway trucks and locomotives, which have a large crankpin and consequently large bearing. A disadvantage of an angled split rod is non symmetrical loading of the connecting rod crankpin bore. The rod cap is now at an angle to the loading, and it makes the cap slide with respect to the upper rod, thus requiring additional attention to cap locating.

A one piece connecting rod enables a rolling element bearing to be used to reduce engine friction. However, the application of a one piece connecting rod is usually limited to engines with an assembled crankshaft, to provide access to assemble the bearing and crankpin through the middle of the connecting rod. A one piece connecting rod is lighter and less expensive than a plain rod since rod cap fasteners are not required, however a bearing quality surface is required on the crankpin end, since the rollers ride directly on the rod.

An articulated rod is used for radial engines where more than one connecting rod must attach to the same crank journal. This arrangement reduces the axial length of the crankpin journal for multiple cylinders, and is most common in air-cooled radial aircraft engines. All connecting rods attach to the same crankpin to allow all cylinders to face the cooling airflow equally.

Regardless of crankpin bore arrangement, the job of the connecting rod is to keep the crankpin bearing as round as possible to ensure an even oil film and prevent contact of the rod bearing to the crankshaft. The connecting rod cap may have reinforcing ribs to increase stiffness. A single rib is easiest to cast or forge, but a double rib is a more efficient distribution of stiffness.



Construction of Crank case:

A crankcase is the housing for the crankshaft in a reciprocating internal combustion engine. In most modern engines, the crankcase is integrated into the engine block.

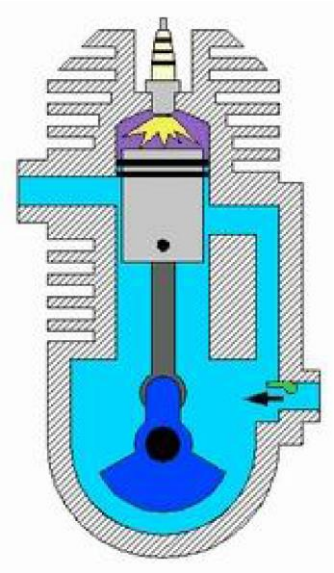
Two-stroke engines typically use a crankcase-compression design, resulting in the fuel/air mixture passing through the crankcase before entering the cylinder(s). This design of engine does not include an oil sump in the crankcase.

Four-stroke engines typically have an oil sump at the bottom of the crankcase and the majority of the engine's oil is held within the crankcase. The fuel/air mixture does not pass through the crankcase in a four-stroke engine, however a small amount of exhaust gasses often enter as "blow-by" from the combustion chamber.

The crankcase often forms the lower half of the main bearing journals (with the bearing caps forming the other half), although in some engines the crankcase completely surrounds the main bearing journals.

An "open-crank" engine has no crankcase. This design was used in early engines and remains in use in some large diesel engines, such as used in ships.

Two-stroke engines



Crankcase Compression

Many two-stroke engines use a crankcase-compression design, where a partial vacuum draws the fuel/air mixture into the engine as the piston moves upwards. Then as the piston travels downward, the inlet port is uncovered and the compressed fuel/air mixture is pushed from the crankcase into the into the combustion chamber.

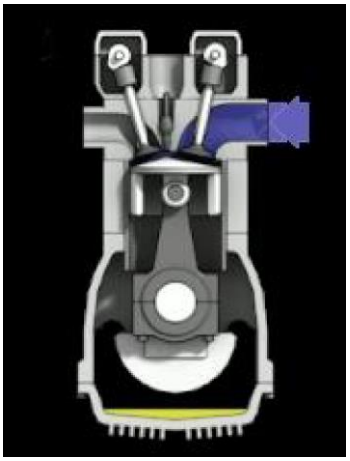
Crankcase-compression designs are often used in small petrol (gasoline) engines for motorcycles, generator sets and garden equipment. This design has also been used in some small diesel engines, however it is less common.

Both sides of the piston are used as working surfaces: the upper side is the power piston, the lower side acts as a pump. Therefore an inlet valve is not required. Unlike other types of engines, there is no supply of oil to the crankcase, because it handles the fuel/air mixture. Instead, two-stroke oil is mixed with the fuel used by the engine and burned in the combustion chamber.

Lubricating crankcase

Large two-stroke engines do not use crankcase compression, but instead a separate scavenge blower or supercharger to draw the fuel/air mixture into the compression chamber. Therefore the crankcases are similar to a four-stroke engine in that they are solely used for lubrication purposes.

Four-stroke engines



Most four-stroke engines use a crankcase that contains the engine's lubricating oil, as either a wet sump system or the less common dry sump system. Unlike a two-stroke (crankcase-compression) engine, the crankcase in a four-stroke engine is not used for the fuel/air mixture.

Oil circulation

Engine oil is recirculated around a four-stroke engine (rather than burning it as happens in a two-stroke engine) and much of this occurs within the crankcase. Oil is stored either at the bottom of the crankcase (in a wet sump engine) or in a separate reservoir (in a dry sump system). From here the oil is pressurized by an oil pump (and usually passes through an oil filter) before it is squirted into the crankshaft and connecting rod bearings and onto the cylinder walls, and eventually drips off into the bottom of the crankcase.

Even in a wet sump system, the crankshaft has minimal contact with the sump oil. Otherwise, the high-speed rotation of the crankshaft would cause the oil to froth, making it difficult for the oil pump to move the oil, which can starve the engine of lubrication. Oil from the sump may splash onto the crankshaft due to g-forces or bumpy roads, which is referred to as windage.

Ventilation of combustion gases

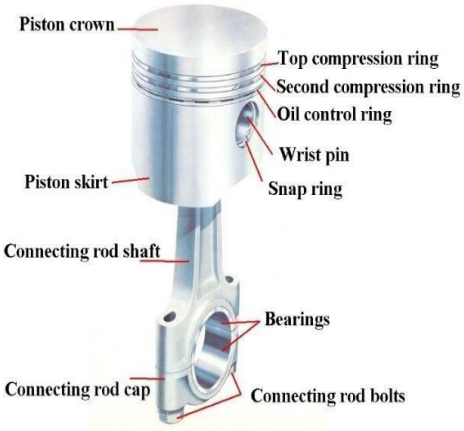
Although the piston rings are intended to seal the combustion chamber from the crankcase, it is normal for some combustion gasses to escape around the piston rings and enter the crankcase. This phenomenon is known as *blow-by*. If these gases accumulated within the crankcase, it would cause unwanted pressurisation of the crankcase, contamination of the oil and rust from condensation. To prevent this, modern engines use a *crankcase ventilation system* to expel the combustion gasses from the crankcase. In most cases, the gasses are passed through to the intake manifold.

A piston is a component of reciprocating engines, reciprocating pumps, gas compressors and pneumatic cylinders, among other similar mechanisms. It is the moving component that is contained by a cylinder and is made gas-tight by piston rings. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the crankshaft via a piston rod and/or connecting rod. In a pump, the function is reversed and force is transferred from the crankshaft to

the piston for the purpose of compressing or ejecting the fluid in the cylinder. In some engines, the piston also acts as a valve by covering and uncovering ports in the cylinder.

Construction of a Piston

The piston of a reciprocating engine is a cylindrical member which moves back and forth within a steel cylinder. The piston acts as a moving wall within the combustion chamber. As the piston moves down in the cylinder, it draws in the fuel/air mixture. As it moves upward, it compresses the charge, ignition occurs, and the expanding gases force the piston downward. This force is transmitted to the crankshaft through the connecting rod. On the return upward stroke, the piston forces the exhaust gases from the cylinder.



Design Considerations For a Piston

It should have enormous strength to withstand the high gas pressure and inertia forces.

It should have minimum mass to minimise the inertia forces.

It should form an effective gas and oil sealing of the cylinder.

It should provide sufficient bearing area to prevent undue wear.

It should disperse the heat of combustion quickly to the cylinder walls.

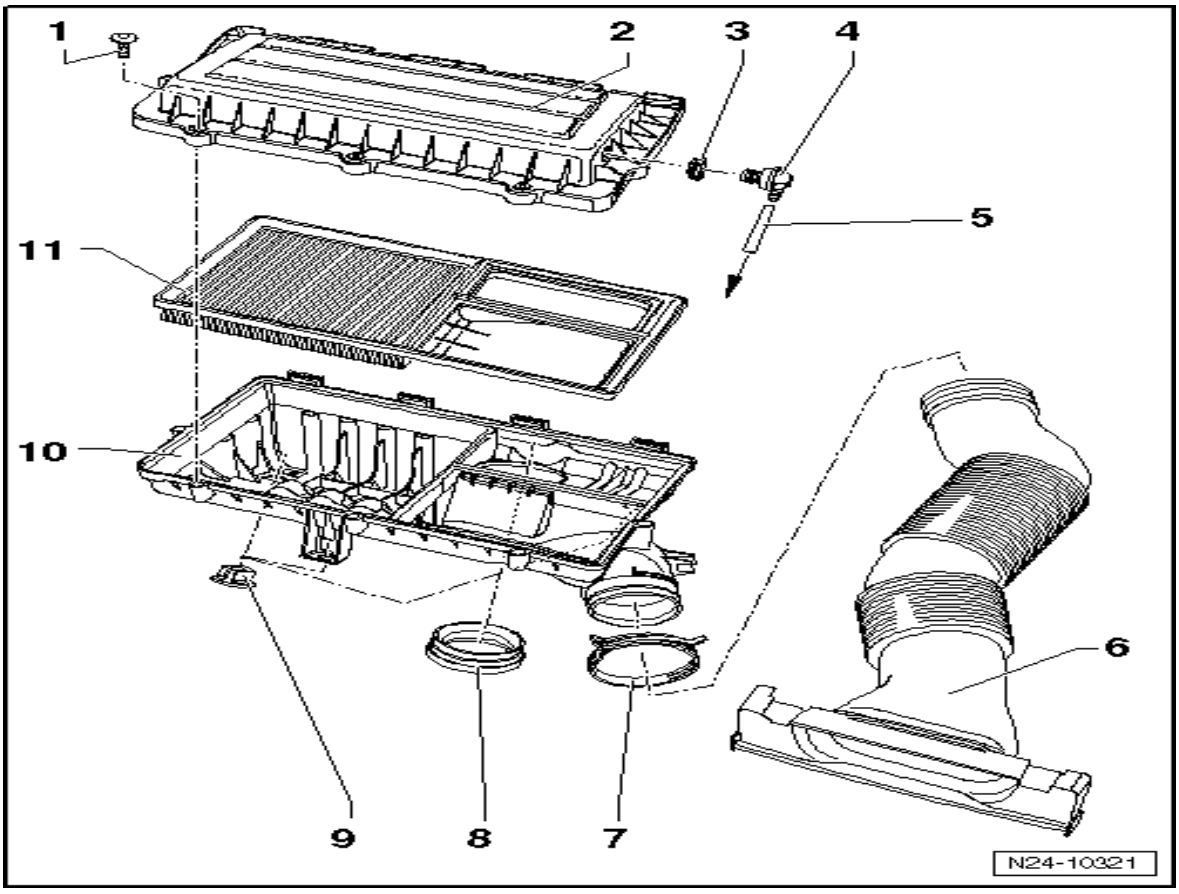
It should have high speed reciprocation without noice.

It should be of sufficient rigid construction to withstand thermal and mechanical distortion.

It should have sufficient support for the piston pin.

Air Filter:

A particulate air filter is a device composed of fibrous or porous materials which removes solid particulates such as dust, pollen, and bacteria from the air. They are also used in internal combustion engines as well. The combustion air filter prevents abrasive particulate matter from entering the engine's cylinders, where it would cause mechanical wear and oil contamination. Most fuel injected vehicles use a pleated paper filter element in the form of a flat panel. As different types are taken in through intake air it requires filtration. There's where air filters are used to increase the efficiency of the engine. Air intake has many particles of different sizes such as sand, dust, moisture, soot, etc the air filters stops these particles from entering the engine. All the air filter has a tight seal this ensures the air passing through is clean. Then clean air passes through the mass air meter measuring the air is vital for engine to have a long life and great efficiency. Every air filter has a life which needs to be checked.



A throttle valve in the form of a flat circular metal disc Mounted on a spindle. This is provided for controlling The flow of air-fuel mixture to the induction manifold. A rotary type valve also can be used instead of disc Type. The level of fuel is just kept slightly below the top of The jet to prevent the leakage when not in operation. Normally 1.5 mm difference is kept between the top of The jet and the surface of the fuel in the float chamber.

Types of carburettor

01) Updraft Type: In this, the air enters the Carburettor at the bottom and leaves at the top.

02) Downdraft Type: In this, air enters the Carburettor at the top and leaves at the bottom. This is used in most of the passenger cars. Because it can be installed at a higher level in The engine. Hence makes it more accessible For the purpose of inspection and repair.

03) Side draft Type: It has more width and Mounting of oil bath air filter is clumsy Working of carburettor A needle valve controls the passage of fuel from the fuel pump when the air begins to flow past the jet; a low-pressure zone is created in the venture because of the increased velocity Of air. The fuel begins to rise because of the difference in the air pressure on the fuel which Is equal to the pressure of the atmosphere and On the fuel in the jet at the venturi and issue out From the jet in the form of a fine spray Minute petrol particles present a large surface Area being exposed to the air stream. When two concentric venturi is provided, the discharge end of the inner venturi called “Primary Venturi”. This lies just at the throat of the main venturi. A higher velocity of air which aids in the atomization of the fuel is obtained at the throat of primary venturi. As there is a lower pressure compared to the main venturi. The main advantages of multiple venturi are, these keep the fuel away from the carburetor walls. Hence obtain the considerable reduction in fuel consumption.

Function of spark plug

The plug is connected to the high voltage generated by an ignition coil or magneto. As the electrons flow from the coil, a voltage difference develops between the center electrode and side electrode. No current can flow because the fuel and air in the gap is an insulator, but as the voltage rises further, it begins to change the structure of the gases between the electrodes. Once the voltage exceeds the dielectric strength of the gases, the gases become ionized. The ionized gas becomes a conductor and allow electrons to flow across the gap. Spark plugs usually require voltage in excess of 20,000 volts to 'fire' properly

Construction of spark plug

A spark plug is composed of a shell, insulator and the central conductor. It passes through the wall of the combustion chamber and therefore must also seal the combustion chamber against high pressures and temperatures without deteriorating over long periods of time and extended use.

Labelling of spark plug

A spark plug is made of a center electrode, an insulator, a metal casing or shell, and a side electrode (also called a ground electrode). OR A spark plug has a metal threaded shell,

electrically isolated from a central electrode by a porcelain insulator. The central electrode, which may contain a resistor, is connected by a heavily insulated wire to the output terminal of an ignition coil or magneto

Introduction of carburettor

A carburettor is a device that blends air and fuel in the proper ratio for the combustion in an internal combustion engine. In automobile engineering, it is most important to supply proper air-fuel ratio in inlet manifold of the internal combustion engine. A good Carburettor will do this for your engine. Internal combustion engine has very low comparison ratio. It also uses highly volatile liquid fuel such as petrol, paraffin etc. Hence the carburetion process is must requirement.

Engine bearing:

Engine bearing should have lubricant property and strength to withstand in moving load. So its half is made of steel or bronze back to which a lining of relatively soft bearing material is applied.

Bore is the diameter of each cylinder and stroke is the length that it travels when moving from bottom position to the top position. Thus if the engine has 1 cylinder with bore x stroke of 78 x 52.3 mm it's total displacement will be: where $\pi = 3.1416...$ and the bore and stroke must be in cm, thus divide them by 10 to get the right dimension. Engines with the bore bigger than stroke (like your example) are called over square engines, with the bore smaller than stroke are called under square engines and exactly equal are called square engines.

Over square engines allow bigger or multiple valves in the head and have less loss to friction due to the shorter stroke, but are only efficient at higher revs thus are more typical in high performance engines, like in your example for a sport bike. Bigger engines also have a larger bore even in trucks to limit the length of the stroke, thus limiting losses of the pistons rubbing the rings.

Under square engines allow for a better torque in low revolutions where the longer stroke will not affect performance so much but the fuel burn will be more efficient due to the lower volume when the air/fuel mixture is compressed, leading also to lower fuel consumption. Diesel engines also are massively undersquare engines (typically around 3:1 ratio) since those engines have a very high compression ratio compared to gas engines (around 22:1 ratio).