Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

Fabrication of Different Types of Cylinders for Four Stroke Engine

M. Sandeep Assistant Professor
B. Sunil Kumar-14AG1A0372, Student
P Sai Phani Kumar-14AG1A03A3, Student
J.Srikanth-14AG1A0399 Student
Ace Engineering College,
Jawahar Nehru Technological University

***Abstract* - The main purpose of my project is to study the types of cylinders and their firing order and also to fabricate the prototype of a 4-stroke four cylinder engine. The four stroke engine mainly divided into 2 types based upon their use of fuels. (i.e., petrol and diesel).**

Based on the volume(cc) of an engine the cylinders are manufactured, and are classified into different types in-line, v-type, horizontal, w-type, and radial cylinders. the firing orders are different for different types of cylinders and were given correct orders to overcome from vibrations and from superheated zone.

The various process involved in the fabrication of prototype are raw material cutting, grinding and machining. Under this processes like lathe machine and their application process, chamfering and tapering etc is done respectively.

The arc welding is used to fabricate the mildsteel (M.S.) prototype of four stroke four cylinder engine.these are widely used in ships, locomotives and other automotives.

CHAPTER-1
INTRODUCTION:-

The four stroke engine is probably the most common engine type nowadays. It powers almost all cars and trucks. Four stoke engine is internal combustion engine. An internal combustion engine is any engine that operates by burning its fuel inside the engine. In contrast an external combustion engine burns its fuel outside the engine like in steam engine. In 4 stroke engine an explosive mixture is drawn into the cylinder on the first stroke and is compressed and ignited on the second stroke; work is done on the third stroke and the products of combustion are exhausted on the fourth stroke.

CHAPTER-2

History And Invention:

Many people claimed the invention of internal combustion engine in 1860's, but only one has the patent on the four stroke operating sequence. In 1867, Nikolaus August Otto, a German engineer, developed the four-stroke “Many people claimed the invention of the internal combustion engine in the Otto" cycle, which is widely used in transportation even today. Otto developed the four-stroke internal combustion engine when he was 34 years old. The Diesel Engine came about in 1892 by another German engineer, Rudolph Diesel. The Diesel engine is designed heavier and more powerful than gasoline engines and utilizes oil as fuel. Diesel engines are a commonly used in heavy machinery, locomotives, ships, and some automobiles. The basic operating principles of these engines have been around for more than a hundred years and they are still in place. Some people get discouraged when they look under the hood and cannot recognize a thing on their automobile. Rest assured that underneath all of those wires and sensors lies an engine with the same basic operating principles of that otto engine over a century old.

CHAPTER-3

WORKING OF FOUR STROKE ENGINE:-

The power generation process in four stroke diesel engine is also divided into four parts. Each part is known as piston stroke. In IC engine, stroke is referred to the maximum distance travel by the piston in a single direction. The piston is free to move only in upward and downward direction. In four stroke engine the piston move two time up and down and the crankshaft move two complete revolution to complete four piston cycle. These are suction stroke, compression stroke, expansion stroke and exhaust stroke.

Suction stroke:

In the suction stroke or intake stroke of diesel engine the piston start moves from top end of the cylinder to bottom end of the cylinder and simultaneously inlet valve opens. At this time air at atmospheric pressure drawn inside the cylinder through the inlet valve by a pump. The inlet valve remains open until the piston reaches the lower end of cylinder. After it inlet valve close and seal the upper end of the cylinder.

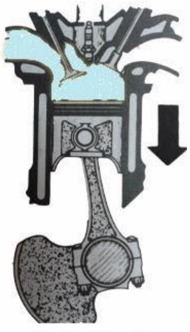


Fig 3.1.1:-diagrammatic view of intake stroke

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

Compression stroke:

After the piston passes bottom end of the cylinder, it starts moving up. Both valves are closed and the cylinder is sealed at that time. The piston moves upward. This movement of piston compresses the air into a small space between the top of the piston and cylinder head. The air is compressed into 1/22 or less of its original volume. Due to this compression a high pressure and temperature generate inside the cylinder. Both the inlet and exhaust valves do not open during any part of this stroke. At the end of compression stroke the piston is at top end of the cylinder.

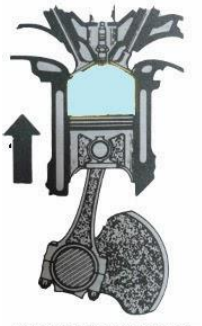


Fig 3.1.2:-diagrammatic view of compression stroke

Power stroke:

At the end of the compression stroke when the piston is at top end of the cylinder a metered quantity of diesel is injected into the cylinder by the injector. The heat of compressed air ignites the diesel fuel and generates high pressure which pushes down the piston. The connection rod carries this force to the crankshaft which turns to move the vehicle. At the end of power stroke the piston reach the bottom end of cylinder.

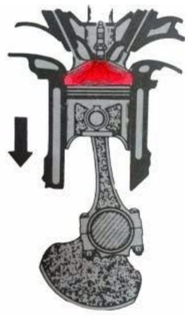


Fig 3.1.3:-diagrammatic view of power stroke

Exhaust stroke:

When the piston reaches the bottom end of cylinder after the power stroke, the exhaust valve opens. At this time the burn gases inside the cylinder so the cylinder pressure is slightly high from atmospheric pressure. This pressure difference allows burn gases to escape through the exhaust port and the piston move through the top end of the cylinder. At the end of exhaust all burn gases escape and exhaust valve closed. Now again intake valve open and this process running until your vehicle starts.

Fig 3.1.4:-diagrammatic view of exhaust stroke

CHAPTER-4

FUNCTION OF FOUR STROKE ENGINE:

- In a four stroke engine, there is only a power stroke in every two rotations of the crank shaft since the thermodynamic cycle is completed in four strokes of the piston. Because of the above reason, the turning moment is less uniform. So a heavier fly wheel is used in the case of a four stroke engine.
- Because of the production of only a power stroke in each two rotations of the crank shaft, the power produced is half compared to two stroke engine if the size is same.
- There is valve system provided for four stroke engine. This made the working and design of this engine complex.
- Due to the presence of valve system and increased weight, the initial production cost of four strike engines is high.
- In the case of four stroke engine, the volumetric efficiency is high due to larger time for induction.
- Here, thermal efficiency is higher and part load efficiency is better.
- There is less chance for incomplete burning and so less chances for environmental pollution.
- These engines are used where efficiency is important. Examples are in cars, buses, trucks, etc.

CHAPTER-5

Classification of Internal Combustion Engines

Types of engines

There are two major cycles used in internal combustion engines: Otto and Diesel. The Otto cycle is named after Nikolaus Otto (1832 – 1891) who developed a fourstroke engine in 1876. It is also called a spark ignition (SI) engine, since a spark is needed to ignite the fuel-air mixture. The Diesel cycle engine is also called a compression ignition (CI) engine, since the fuel will auto-ignite when injected into the combustion chamber. The Otto and Diesel cycles operate on either a four- or twostoke cycle. Since the invention of the internal combustion engine many pistons-cylinder geometries have been designed. The choice of given arrangement depends on a number of factors and constraints, such as engine balancing and available volume:

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

TYPES & CLASSIFICATIONS OF IC ENGINES:

- IC engines can be classified according to:

1.Applications
Automobile truck locomotive,light aircraft,marine,portable,powersystem etc
2.Basic engine design
Reciprocatingengine,rotaryengine
3.No of cylinders
1,2,3,4,5,6,8,10,12 etc
4.Arrangement of cylinder
In-line,V type ,opposed, radial
5.Working cycle
4stroke,2stroke
6.Fuel
Gasoline,disel,nitromethane,alcohol,naturalgas,hydrogen etc

1. Reciprocating:
(a) Single Cylinder
(b) Multi-cylinder
(I) In-line
(ii) V
(iii) Radial
(iv) Opposed Cylinder
(v) Opposed Piston
2. Rotary:
(a) Single Rotor
(b) Multi-rotor

Single cylinder

Fig 5.1:-single cylinder

In Line engine:-

The inline-four engine or straight-four engine is an internal combustion engin with all four cylinders mounted in a straight line, or plane along the crankcase. The single bank of cylinders may be oriented in either a vertical or an inclined plane with all the pistons driving a common crankshaft. Where it is inclined, it is sometimes called a slant-four. In a specification chart or when an abbreviation is used, an inline-four engine is listed either as I4 or L4. The inline-four layout is in perfect primary balance and confers a degree of mechanical simplicity which makes it popular for economy cars. However, despite its simplicity, it suffers from a secondary imbalance which causes minor vibrations in smaller engines. These vibrations become worse as engine size and power increase, 15 so the more powerful engines used in larger cars generally are more complex designs with more than four cylinders. Today almost all manufacturers of four cylinder engines for automobilles produce the inline-four layout, with Subaru's flat-four being a notable exception, and so four cylinder is synonymous with and a more widely used term than inline-four. The inlinefour is the most common engine configuration in modern cars, while the V6 is the second most popular. In the late 2000s, with auto manufacturers making efforts to increase fuel efficiency and reduce emissions, due to the high price of oil and the economic recession, the proportion of new vehicles with four cylinder engines (largely of the inline-four type) has risen from 30 percent to 47 percent between 2005 and 2008, particularly in mid-size vehicles where a decreasing number of buyers have chosen the V6 performance option. Usually found in four- and six-cylinder configurations, the straight engine, or inline engine is an internal combustion engine with all cylinders aligned in one row, with no offset. A straight engine is considerably easier to build than an otherwise equivalent horizontally opposed or V-engine, because both the cylinder bank and crankshaft can be milled from a single metal casting, and it requires fewer cylinder heads and camshafts. In-line engines are also smaller in overall physical dimensions than designs such as the radial, and can be mounted in any direction. Straight configurations are simpler than their V-shaped counterparts. They have a support bearing between each piston as compared to "flat and V" engines which have 16 support bearings between every two pistons. Although six-cylinder engines are inherently balanced, the four-cylinder models are inherently off balance and rough, unlike 90 degree V fours and horizontally opposed 'boxer' 4 cylinders. An even-firing inline-four engine is in primary balance because the pistons are moving in pairs, and one pair of pistons is always moving up at the same time as the other pair is moving down. However, piston acceleration and deceleration are greater in the top half of the crankshaft rotation than in the bottom half, because the connecting rods are not infinitely long, resulting in a non sinusoidal motion. As a result, two pistons are always accelerating faster in one direction, while the other two are accelerating more slowly in the other direction, which leads to a secondary dynamic imbalance that causes an up-and-down vibration at twice crankshaft speed. This imbalance is tolerable in a small, low-displacement, low-power configuration, but the vibrations get worse with increasing size and power. The reason for the piston's higher speed during the 180° rotation from mid-stroke through top-dead-centre, and back to mid-stroke, is that the minor contribution to the piston's up/down movement from the connecting rod's change of angle here has the same direction as the major contribution to the piston's up/down movement from the up/down movement of the crank pin. By contrast, during the 180° rotation from mid stroke through bottom-dead-centre and back to mid-stroke, the minor contribution to the piston's up/down movement from the connecting rod's change of angle has the opposite direction of the major contribution to the piston's up/down movement from the up/down movement of the crank pin. Four cylinder engines also have a smoothness problem in that the power strokes of the pistons do not overlap. With four cylinders and four strokes to complete in the four-stroke cycle, each piston must complete its power stroke and come to a complete stop before the next piston can start a new power stroke, resulting in a pause between each power stroke and a pulsating delivery of power. In engines with more cylinders, the power strokes overlap, which gives them a smoother delivery of power and less vibration than a four can achieve. As a result, six- and eight-cylinder engines are generally used in more luxurious and expensive cars When a straight engine is mounted at an angle from the vertical it is called a slant engine. Chrysler's Slant 6 was used in many models in the 1960s and 1970s. Honda also often mounts its straight-4 and straight-5 engines at a slant, as on 17 the Honda S2000 and Acura Vigor. SAAB first used an inline-4 tilted at 45 degrees for the Saab 99, but later versions of the engine were less tilted. Two main factors have led to the recent decline of the straight-6 in automotive applications. First, Lanchester balance shafts, an old idea reintroduced by Mitsubishi in the 1980s to overcome the natural imbalance of the straight-4 engine and rapidly adopted by many other manufacturers, have made both straight-4 and V6- engine smoother-running; the greater smoothness of the straight-6 layout is no longer such an advantage. Second, fuel consumption became more important, as cars became smaller and more space-efficient. The engine bay of a modern small or medium car, typically designed for a straight-4, often does not have room for a straight-6, but can fit a V6 with only minor modifications. Straight-6 engines are used in some models from BMW, Ford Australia, Chevrolet, GMC, Toyota, Suzuki and Volvo Cars.

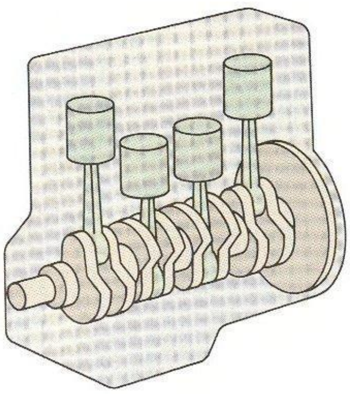


Fig 5.2:-inline cylinder

V ENGINE

V engine or Vee engine is a common configuration for an internal combustion engine. The cylinders and pistons are aligned in two separate planes or "banks", is that they appear to be in a "V" when viewed along the axis of the crankshaft. The Vee configuration generally reduces the overall engine length, height and weight compared to the equivalent inline configuration. Various cylinder bank angles of Vee are used in different engines depending on the number of the cylinders; there may be angles that work better than others for stability. Very narrow angles of V combine some of the advantages of the straight and V engine. The most common of V engines is V6. It is an engine with six cylinders mounted on the crankcase in two banks of three cylinders, usually set at either a right angle or an accurate angle to each other, with all six pistons driving a common crankshaft. It is second common engine configuration in modern cars after the inline-four. It is becoming more common as the space allowed in modern cars is reduced at the time as power requirements increase, and has largely replaced the inline-6, which is too long to fit in the many modern engine compartments. Although it is more complicated and not as smooth as the inline-6, the V6 is more rigid for a given weight, more compact and less prone to torsional vibrations in the crankshaft for a given displacement. The V6 engine has become widely adopted for medium-sized cars, often as an optional engine where a straight 4 is standard, or as a base engine where a V8 is a higher-cost performance. 21 The most efficient cylinder bank angle for V6 is 60 degrees, minimizing size and vibration. While 60 degrees V6 are not as well balanced as inline-6 and flat-6 engines, modern techniques for designing and mounting engines have largely disguised their vibrations. Unlike most others angles, 60 degree V6 engines can be made acceptably smooth without the need for balance shafts. 90° V6 engines are also produced, usually so they can use the same production-line tooling set up to produce V8 engines (which normally have a 90° V angle). Although it is easy to derive a 90° V6 from an existing V8 design by simly cutting cylinders off the engine, this tends to make it wider and more vibration-prone than a 60° V6. 120° might be described as the natural angle for a V6 since the cylinders fire every 120° of crankshaft rotation. Unlike the 60° or 90° configuration, it allows pairs of pistons to share crank pins in a three-throw crankshaft without requiring flying arms or split crankpins to be even-firing. The 120° layout also produces an engine which is too wide for most automobile engine compartments, so it is more often used in racing cars where the car is designed around the engine rather than vice-versa, and vibration is not as important

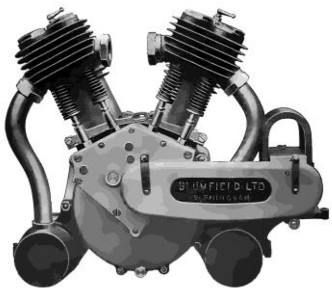


Fig 5.3:-v-type cylinder

Radial Engine

The radial engine is a reciprocating type internal combustion engine configuration in which the cylinders point outward from a central crankshaft like the spokes on a wheel. This configuration was very commonly used in large aircraft engines before most large aircraft started using turbine engines. In a radial engine, the pistons are connected to the crankshaft with a master-andarticulating-rod assembly. One piston has a master rod with a direct attachment to the crankshaft. The remaining pistons pin their connecting rods` attachment to rings around the edge of the master rod. Four-stroke radials always have an odd number cylinders per row, so that a consistent every-other-

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

piston firing order can be maintained, providing smooth operation. This achieved by the engine talking two revolution of the crankshaft to complete the four stokes (intake, compression, power, exhaust), which means the firing order is 1,3,5,2,4 and back to cylinder 1 again. This means that there is always a two-piston gap between the piston on its power stroke and the next piston on fire (piston compression). If an even number of cylinders was uses, the firing order would be something similar to 1,3,5,2,4,6 which leaves a threepiston gap between firing piston on the first crank shaft revolution and only onepiston gap on the second. This leads to an uneven firing order within the engine, and is not ideal. Originally radial engines had one row of cylinders, but as engine sizes increased it become necessary to add extra rows. The first known radial-configuration engine 20 using a twin-row was “Double Lambda” from 1912, designed as a 14 cylinder twinrow version. While most radial engines have been produced for gasoline fuels, there have been instances of diesel fueled engines. The Bristol Phoenix of 1928-1932 was successfully tested in aircraft and the Nordberg Manufacturing Company of the US developed and produce series of large diesel engines from the 1940s. The companies that build rotary engines nowadays are Vedeneyev, Rotec Engineering, HCI Aviation and Verner Motors.

Fig 5.4:-Radial cylinder

Horizontally opposed:-

A horizontally opposed engine is an engine in which the two cylinder heads are on opposite side of the crankshaft, resulting in a flat profile. Subaru and Porsche are two automakers that use horizontally opposed engine in their vehicles. Horizontally opposed engines offer a low centre of gravity and thereby may a drive configuration with better stability and control. They are also wider than other engine configurations, presenting complications with the fitment of the engine within the engine bay of a front-engine car. This kind of engine is wide spread in the aircraft production. Typically, the layout has cylinders arranged in two banks on the either side of the single crankshaft and is generally known as boxer. 18 Boxers got their name because each pair of piston moves simultaneously in and out, rather than alternately, like boxers showing they are ready by clashing their gloved fists against each other before a fight. Boxer engines of up to eight cylinders have proved highly successful in automobiles and up to six in motorcycles and continue to be popular for the light aircrafts engine. Boxers are one of only three cylinder layouts that have a natural dynamic balance; the others being the straight-6 and the V12. These engines can run very smoothly and free of unbalanced forces with a four-stroke cycle and do not require a balance shaft or counterweights on the crankshaft to balance the weight of the reciprocating parts, which are required in other engine configurations. However, in the case of boxer engines with fewer than six cylinders, unbalanced moments (a reciprocating torque also known as a "rocking couple") are unavoidable due to the "opposite" cylinders being slightly out of line with each other. Boxer engines (and flat engines in general) tend to be noisier than other common engines for both intrinsic and other reasons, valve clatter from under the hood is not damped by large air filters and other components. Boxers need no balance weights on the crankshaft, which should be lighter and fast-accelerating - but, in practice (e.g. in cars), they need a flywheel to run smoothly at low speeds and this negates the advantage. They have a characteristic smoothness throughout the rev range and offer a low centre of gravity

Fig 5.5:-opposed cylinder

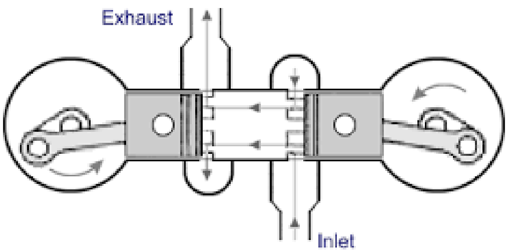


Fig 5.6:-horizontal opposed cylinder

CHAPTER-6

FIRING ORDER:-

The firing order is the order in which each cylinder makes a power stroke in a multicycle engine.

The main reason for having a firing order is to balance the engine power and to achieve less vibration for the engine and the vehicle. If the firing order is not appropriately selected to balance the engine the following failures or defects can be noticed.

1. More vibration for the vehicle.
2. Self loosening or failure of engine mounting bolts.
3. Continuous engine failure due to more fatigue on the unit.
4. Abrupt engine failure. Etc

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

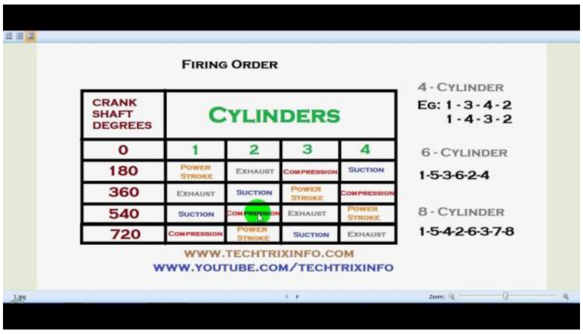


Fig 6.1:-firing orders

The firing order is the sequence of power delivery of each cylinder in a multi-cylinder reciprocating engine.

This is achieved by sparking of the spark plugs in a gasoline engine in the correct order, or by the sequence of fuel injection in a Diesel engine. When designing an engine, choosing an appropriate firing order is critical to minimizing vibration, to improve engine balance and achieving smooth running, for long engine fatigue life and user comfort, and heavily influences crankshaft design.

Cylinder numbering and firing order of an engine:-

In a straight engine the spark plugs (and cylinders) are numbered, starting with #1, usually from the front of the engine to the rear.

1-3-5-2-4 would be the firing order for this 5-cylinder radial engine.

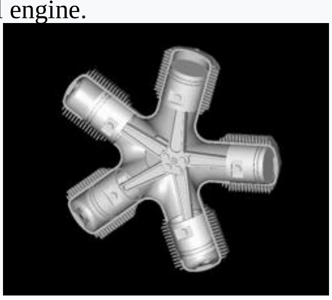
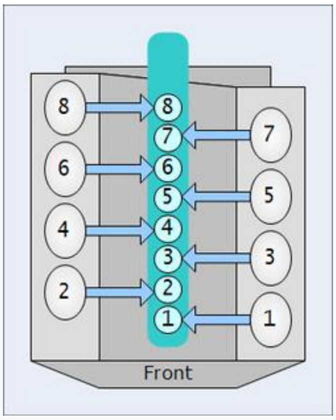


Fig 6.2:-radial engine firing order

In a radial engine the cylinders are numbered around the circle, with the #1 cylinder at the top. There are always an odd number of cylinders in each bank, as this allows for a constant alternate cylinder firing order: for example, with a single bank of 7 cylinders, the order would be 1-3-5-7-2-4-6. Moreover, unless there is an odd number of cylinders, the ring cam around the nose of the engine would be unable to provide the inlet valve open - exhaust valve open sequence required by the four-stroke cycle.



The cylinder numbering scheme used by some manufacturers on their V engines is based on "folding" the engine into an inline type.

In a V engine, cylinder numbering varies among manufacturers. Generally speaking, the most forward cylinder is numbered 1, but some manufacturers will then continue numbering along that bank first (so that side of the engine would be 1-2-3-4, and the opposite bank would be 5-6-7-8) while others will number the cylinders from front to back along the crankshaft, so one bank would be 1-3-5-7 and the other bank would be 2-4-6-8. (In this example, a V8 is assumed). To further complicate matters, manufacturers may not have used the same system for all of their engines. It is important to check the numbering system used before comparing firing orders, because the order will vary significantly with crankshaft design (see crossplane).

As an example, the Chevrolet Small-Block engine has cylinders 1-3-5-7 on the left hand side of the car, and 2-4-6-8 on the other side, and uses a firing order of 1-8-4-3-6-5-7-2.[2] Note that the order alternates irregularly between the left and right banks; this is what causes the 'burbling' sound of this type of engine.[3]

In most Audi and Ford V8 engines cylinders 1-2-3-4 are on the right hand side of the car, with 5-6-7-8 are on the left.

Likewise, the firing pattern is the same for Chevrolet & Chrysler V8 engines with a firing order of 1-8-4-3-6-5-7-2, and for Ford's V8 engines with a firing order of 1-5-4-2-6-3-7-8.

CHAPTER-7

Fabrication With Different Types If Cylinders:-

The fabrication of an prototype of a four stroke engine involves machining processes like cutting; grinding; chamfering and tapering under lathe process.

Here we use different type of raw materials to fabricate the four-stroke engine with different cylinders.

Four stroke engine with single cylinder :-

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

Four stroke engine with double cylinder :-

Four stroke cylinder with four cylinder :-

CHAPTER-8

BASIC ENGINE PARTS:-

1 Cylinder block:-

The cylinder block is the main supporting structure for the various components. The cylinders of multi-cylinder engine are cast as single unit, called cylinder block. The cylinder head mounted on the cylinder block .The cylinder head and cylinder block are provided with water jacket for cooling.

Fig 8.1:-cylinder block

2 Cylinders:-

As the name implies it is a cylindrical vessel or space in which the piston makes a reciprocating motion. The varying volume created in the cylinder during the operation of the engine is filled with the working fluid and subjected to different thermodynamics processes such as suction, compression, combustion, expansion and exhaust .The cylinder is supported in supporting block.

3 Combustion chamber:-

The space enclosed in the upper part of the cylinder, by the cylinder head and the piston top during the combustion process, is called the combustion chamber.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

4 Pistons:-

Piston is the heart of the engine. The functions of the piston are to compress the charge during the compression stroke and to transmit the gas force to the connecting rod and then to the crank during power stroke. The piston is a disc which reciprocates within cylinder. It is either moved by the fluid or it moves the fluid which enters the cylinder. The main function of the piston of an internal combustion engine is to receive the impulse from the expanding gas and to transmit the energy to the crankshaft through the connecting rod. The piston of internal combustion engines are usually of trunk type. This type of piston consists of different parts such as Head or Crown, Piston rings, Skirt, Piston pin etc.

Fig 8.2:-pistons

5 Piston Rings:-

Piston rings provide a sliding seal between the outer edge of the piston and the inner edge of the cylinder. The rings serve two purposes:

1. They prevent the fuel/air mixture and exhaust in the combustion chamber from leaking into the sump during compression and combustion.

2. They keep oil in the sump from leaking into the combustion area, where it would be burned and lost.

A piston ring is an open-ended ring that fits into a groove on the outer diameter of a piston in an internal combustion engine. The gap in the piston ring compresses to a few thousandths of an inch when inside the cylinder bore.

Fig 8.3:-piston rings

6 Inlet manifold:-

The pipe which connects the intake system to the inlet valve of the engine and through which air or air-fuel mixture is drawn in to the cylinder is called inlet manifold.

Fig 8.4:-Inlet manifold.

7 Exhaust manifold:-

The pipe which connects the exhaust system to the exhaust valve of the engine and through which the product of combustion escape in to the atmosphere is called the exhaust manifold.

Fig 8.5:-Exhaust manifold.

8 Inlet and exhaust valve:-

Valves are commonly mushroom shaped poppet type. They are provided either on the cylinder head or on the side of the cylinder for regulating the charge coming in to the cylinder (inlet valve) and for discharging the products of combustion from the cylinder (exhaust valve).

Fig 8.6:-Inlet and Exhaust valves.

9 Connecting Rod: -

The connecting rod connects the piston to the crankshaft. It can rotate at both ends so that its angle can change as the piston moves and the crankshaft rotates. The small end attaches to the piston pin, gudgeon pin (the usual British term) or wrist pin, which is currently most often press fit into the con rod but can swivel in the piston, a "floating wrist pin" design. The big end connects to the bearing journal on the crank throw, running on replaceable bearing shells accessible via the con rod bolts which hold the bearing "cap" onto the big end; typically there is a pinhole bored through the bearing and the big end of the con rod so that pressurized lubricating motor oil squirts out onto the thrust side of the cylinder wall to lubricate the travel of the pistons and piston rings.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

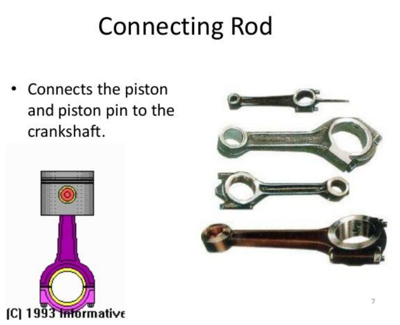


Fig 8.7:-connecting rod

10 Spark Plug:-

The spark plug supplies the spark that ignites the air/fuel mixture so that combustion can occur. The spark must happen at just the right moment for things to work properly.

Fig 8.8:-spark plug.

11 Crank shafts:-

The crankshaft turns the piston's up and down motion into circular motion just like a crank on a jack-in-the-box does. The crankshaft, sometimes casually abbreviated to crank, is the part of an engine which translates reciprocating linear piston motion into rotation. It typically connects to a flywheel, to reduce the pulsation characteristic of the four-stroke cycle, and sometimes a torsional or vibrational damper at the opposite end, to reduce the torsion vibrations often caused along the length of the crankshaft by the cylinders farthest from the output end acting on the torsional elasticity of the metal.

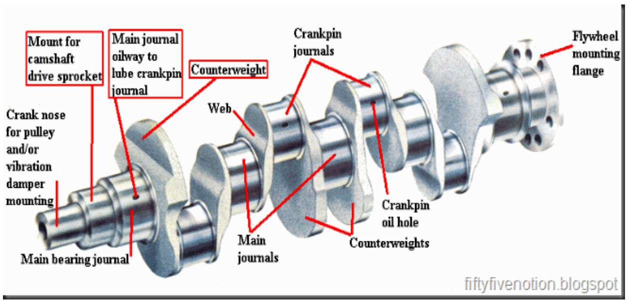


Fig 8.9:-crankshaft

12 Cam shaft:-

The camshaft and its associated parts control the opening and closing of the two valves. The associated parts are push rods, rocker arms, valve springs and tappets. This shaft also provides the drive to the ignition system.

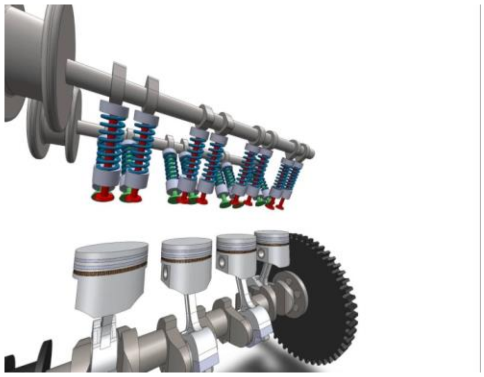


Fig 8.10:-camshaft

13 Gudgeon pin:-

It forms the link between the small end of the connecting rod and the piston.

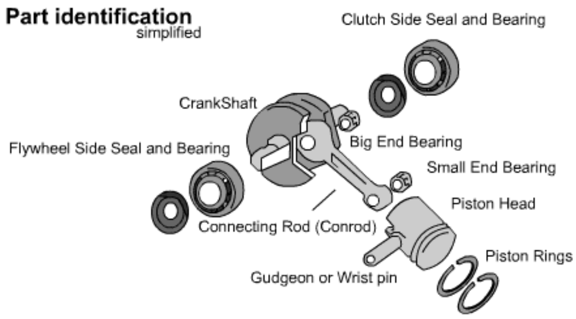


Fig 8.11:-gudgeon pin.

14 Cam:-

These are made as integral parts of the camshaft and are designed in such way to open the valves at the correct timing and to keep them open for necessary duration.

15 Fly wheels:

The net torque imparted to crankshaft during one complete cycle of operation of the engine fluctuates causing a change in the angular velocity of the shaft. In order to achieve a uniform torque an inertia mass in the form of a wheel attached to the output shaft and this wheel is called the flywheel.

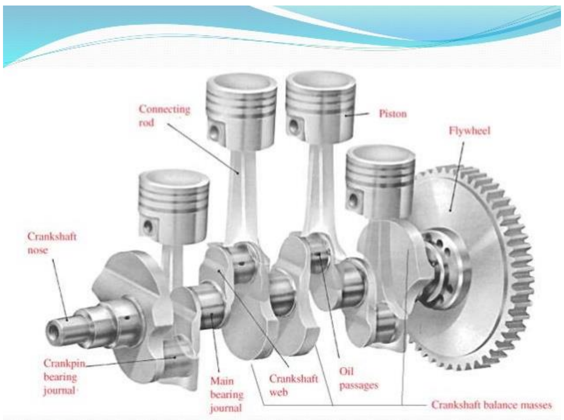


Fig 8.12:-flywheel.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

16 Sumps:-

The sump surrounds the crankshaft. It contains some amount of oil, which collects in the bottom of the sump (the oil pan).

CHAPTER-9

NOMENCLATURE:-

1 Cylinder bore (d):

The nominal inner diameter of the working cylinder is called the cylinder bore. It is expressed in millimetre (mm).

2 Piston areas:

The area of the circle of diameter equal to the cylinder bore is called the piston area. It is expressed by square centimetre (cm^2).

3 Strokes (L):

The nominal distance through which a working piston moves between two successive reversals of its direction of motion is called the stroke & is expressed in millimetre (mm).

4 Stroke to bore ratio:

L/d ratio is an important parameter in classifying the size of the engine.
If d<L, it is called under -square engine.
If d=L, it is called square engine.
If d>L, it is called over -square engine.
An over square engine can operate at higher speeds because of large bore & shorter stroke.

5 Dead centre:

The position of the working piston & the moving parts which are mechanically connected to it, at the moment when the direction of the piston motion is reversed at either end of the stroke is called the dead centre.

There are two dead centres in the engine:
Top dead centre (TDC):

It is the dead centres when the piston is farthest from the crankshaft. It is designated TDC for vertical engines & inner dead centre (IDC) for horizontal engines.
Bottom dead centre (BDC):

It is the dead centre when the piston is nearest to the crankshaft. It is designated as BDC for the vertical engines & outer dead centre (ODC) for horizontal engines.

6 Displacement or Swept volumes:

The nominal volume swept by the working piston when travelling from one dead centre to other is called the displacement volume. It is expressed in terms of cubic centimetre (cc) & given by VS = Ï€d²L/4

7 Cubic Capacity of Engine Capacity:

The displacement volume of a cylinder multiplied by number of cylinders in an engine capacity. For example, if there are K cylinders in an engine, then

Cubic capacity = Vs x K

8 Clearance Volume (Vc):

The nominal volume of the combustion chamber above the piston when it is at the top dead centre is the clearance volume. It is designated as Vc and expressed in cubic centimetre (cc).

9 Compression Ratio (r):

It is the ratio of the total cylinder volume when the piston is at the bottom dead centre, Vt, to the clearance volume, Vc. It is designed by the letter r.

$r = Vt/Vc = (Vc + Vs)/Vc = 1 + Vs/Vc$

10 Brake power:

Power available at crank shaft is known as brake power. It is also the real output power available. Symbolized as B.P

$$B.P = 2\,\pi\,N/60$$

DIFFERENCE BETWEEN 2 STROKE AND 4 STROKE:-

The figure-1 depicts 2 stroke engine (petrol type) and 4 stroke engine (petrol/diesel type). In 4 stroke engine all the four events viz. suction, compression, power and exhaust occur in four different strokes of piston. In 2 stroke engine, suction and compression occur in upward stroke of the piston while power and exhaust occur in downward stroke of the piston.

CHAPTER-10

APPLICATION AND ADVANTAGES:-

4-Stroke engine is now a days very common in heavy and light type machinery b/c of its power and its dependency. It is commonly used in automobiles, motorcycles, power supply generators, trucks, buses It is also used in Air crafts and water crafts further also in automobile rickshaws. Due to its power and regular efficiency it is used in construction work. Armed forces vehicle also implies this type of engine. In agriculture, mostly heavy machinery uses 4-stroke engine like tractors, harvesters, water pumps etc.

ADVANTAGES OF 4-STROKE ENGINE:

- Can produce far more power than 2-stroke engine because they can be made much larger.
- Pollute less than two stroke engines
- More efficient use of gas.

DISADVANTAGES:

- More complex and harder to troubleshoot
- Require oil to be changed regularly.
- More expensive than 2-stroke engine

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 03, March-2018

CHAPTER-11

USED MATERIALS:-

The choice of material for any machine part can be said to depend on the following consideration:

- general function: structural, bearing, sealing, heat

-conducting, space-filling;

- environment: loading, temperature and temperature range, exposure to corrosive condition or to abrasive, wear

- life expectancy

- space and weight limitations

- cost of the finished part and of its maintenance and replacement

- special considerations, such as appearance, customer prejudices.

Material whose essential function is to carry relatively high stresses will here be classed as structural. The heavily stressed materials include those that carry and transmit the forces and torques developed by cylinder pressure and by the inertia of the moving parts in the power train and valve gear. The success of the structural materials is measured by their resistance to structural failure.

When choosing the material for the parts of the engine, it will be taken those materials that have as high as possible resistance to structural failure due to fatigue

CHAPTER-12

CONCLUSION:-

In conclusion that the 4 stroke engines with different cylinders have different cubic centimetres (i.e. they vary in speed).Each type of engines has some advantage over another one. Thus the selection of the appropriate engine requires determining the conditions of application.

REFERENCES:-

[1] Dr. kripal Singh
[2] R.K. Rajput
[3] https://en.wikipedia.org/wiki/Four-stroke_engine
[4] Ralph Stein
[5] "Auto Tech: Atkinson Cycle engines and Hybrids". Autos.ca. 2010-07-14. Retrieved 2013-02-23.
[6] Best Place for Engineering and Technology, Air Standard Assumptions.
[7] Ferreira, Omar Campos (March 1998). "Efficiencies of Internal Combustion Engines". Economia & Energia (in Portuguese). Brasil. Retrieved 2016-04-11.