DOWNLOAD PDF DIESEL ENGINE IGNITION SYSTEM

Chapter 1 : What is an Ignition System? - crankSHIFT

The basic difference between a diesel engine and a gasoline engine is that in a diesel engine, the fuel is sprayed into the combustion chambers through fuel injector nozzles just when the air in each chamber has been placed under such great pressure that it's hot enough to ignite the fuel.

Caterpillar started building diesels for their tractors. Beardmore Tornado diesel engines power the British airship R Yanmar is the first Japanese company to introduce the "HB" series for commercial use. The engine represented a major improvement in power-to-weight ratio and output flexibility over previous generation diesels, drawing the interest of railroad executive Ralph Budd as a prime mover for lightweight trains. First turbo diesel engine for a railway train by Maybach. First streamlined, stainless steel passenger train in the US, the Pioneer Zephyr , using a Winton engine. First tank equipped with diesel engine, the Polish 7TP. Junkers Motorenwerke in Germany started production of the Jumo aviation diesel engine family, the most famous of these being the Jumo , of which over examples were produced by the outbreak of World War II. Mercedes-Benz built the D diesel car. The airship Hindenburg was powered by diesel engines. First series of passenger cars manufactured with diesel engine Mercedes-Benz D, Hanomag and Saurer. BMW experimental airplane diesel engine development. General Motors forms the GM Diesel Division, later to become Detroit Diesel , and introduces the Series 71 inline high-speed medium-horsepower two stroke engine, suitable for road vehicles and marine use. The established the reliability of diesel power in rail service, lending impetus to the dieselization of American railroads. First turbo diesel engine of Saurer. Tatra started production of Tatra with air-cooled V12 diesel engine. Turbo -diesel truck for Mercedes in small series. Turbo-diesel truck in mass production by Volvo. First diesel engine with an overhead cam shaft of Daimler Benz. Every subsequent engine and would incorporate this turbocharger. The diesel drive displaced steam turbines and coal fired steam engines. A diesel compression braking system , eventually to be manufactured by Jacobs of drill chuck fame and nicknamed the "Jake Brake", was invented and patented by Clessie Cummins. Peugeot introduced the first small cars with a transversally mounted diesel engine and front-wheel drive. DAF produced an air-cooled diesel engine. Tested a diesel engine for the Volkswagen Golf passenger car. Peugeot , the first turbo-diesel car to be sold in Europe. Audi , the first passenger car in the world with a turbocharged direct injection and electronic control diesel engine. European emission standards Euro 1 met with the truck diesel engine of Scania. Pump nozzle injection introduced in Volvo truck engines. Unit injector system by Bosch for diesel engines. Mercedes-Benz unveils the first automotive diesel engine with four valves per cylinder. First successful use of common rail in a production vehicle, by Denso in Japan, Hino "Rising Ranger" truck. First diesel engine with direct injection and four valves per cylinder, used in the Opel Vectra. First common rail diesel engine in a passenger car, the Alfa Romeo The combination of high-performance with better fuel efficiency allowed the team to make fewer pit stops during the long endurance race. Volkswagen introduces three and four-cylinder turbodiesel engines, with Bosch-developed electronically controlled unit injectors. Piezoelectric injector technology by Bosch, [52] Siemens and Delphi. The same car won the 24 Hours of Le Mans. Euro 5 for all Iveco trucks. Subaru introduced the first horizontally opposed diesel engine to be fitted to a passenger car. This is a Euro 5 compliant engine with an EGR system. The achievements are repeated in the following season. Volkswagen won the Dakar Rally held in Argentina and Chile. The first diesel to do so. Race Touareg 2 models finished first and second. Mitsubishi developed and started mass production of its 4N13 1. Piaggio launches a twin-cyinder turbodiesel engine, with common rail injection, on its new range of microvans. Common rail systems working with pressures of 2, bar launched. In the Volkswagen emissions scandal , the US EPA issued a notice of violation of the Clean Air Act to Volkswagen Group after it was found that Volkswagen had intentionally programmed turbocharged direct injection TDI diesel engines to activate certain emissions controls only during laboratory emissions testing. Over 80 years of emphasis on two-stroke diesel power by EMD and its ancestral companies comes to an end. Operating principle[edit] p-V Diagram for the Ideal Diesel cycle. The cycle follows the numbers 1â€”4 in clockwise direction. The horizontal axis is Volume of the cylinder. In the diesel cycle the combustion occurs at almost constant pressure. On this diagram the work that is generated for each cycle corresponds to the area within the loop. Diesel engine model, left side Diesel engine model, right side See also: Diesel cycle and Reciprocating internal combustion engine The diesel internal combustion engine differs from the gasoline powered Otto cycle by using highly compressed hot air to ignite the fuel rather than using a spark plug compression ignition rather than spark ignition. In the true diesel engine, only air is initially introduced into the combustion chamber. The air is then compressed with a compression ratio typically between This high compression causes the temperature of the air to rise. At about the top of the compression stroke, fuel is injected directly into the compressed air in the combustion chamber. This may be into a typically toroidal void in the top of the piston or a pre-chamber depending upon the design of the engine. The fuel injector ensures that the fuel is broken down into small droplets, and that the fuel is distributed evenly. The heat of the compressed air vaporizes fuel from the surface of the droplets. The vapour is then ignited by the heat from the compressed air in the combustion chamber, the droplets continue to vaporise from their surfaces and burn, getting smaller, until all the fuel in the droplets has been burnt. Combustion occurs at a substantially constant pressure during the initial part of the power stroke. The start of vaporisation causes a delay before ignition and the characteristic diesel knocking sound as the vapour reaches ignition temperature and causes an abrupt increase in pressure above the piston not shown on the P-V indicator diagram. When combustion is complete the combustion gases expand as the piston descends further; the high pressure in the cylinder drives the piston downward, supplying power to the crankshaft. Increasing the compression ratio in a spark-ignition engine where fuel and air are mixed before entry to the cylinder is limited by the need to prevent damaging pre-ignition. Since only air is compressed in a diesel engine, and fuel is not introduced into the cylinder until shortly before top dead centre TDC , premature detonation is not a problem and compression ratios are much higher. The pâ€”V diagram is a simplified and idealised representation of the events involved in a Diesel engine cycle, arranged to illustrate the similarity with a Carnot cycle. Starting at 1, the piston is at bottom dead centre and both valves are closed at the start of the compression stroke; the cylinder contains air at atmospheric pressure. Between 1 and 2 the air is compressed adiabaticallyâ€”that is without heat transfer to or from the environmentâ€”by the rising piston. This is only approximately true since there will be some heat exchange with the cylinder walls. During this compression, the volume is reduced, the pressure and temperature both rise. At or slightly before 2 TDC fuel is injected and burns in the compressed hot air. Chemical energy is released and this constitutes an injection of thermal energy heat into the compressed gas. Combustion and heating occur between 2 and 3. In this interval the pressure remains constant since the piston descends, and the volume increases; the temperature rises as a consequence of the energy of combustion. At 3 fuel injection and combustion are complete, and the cylinder contains gas at a higher temperature than at 2. Between 3 and 4 this hot gas expands, again approximately adiabatically. Work is done on the system to which the engine is connected. During this expansion phase the volume of the gas rises, and its temperature and pressure both fall. At 4 the exhaust valve opens, and the pressure falls abruptly to atmospheric approximately. This is unresisted expansion and no useful work is done by it. Ideally the adiabatic expansion should continue, extending the line 3â€”4 to the right until the pressure falls to that of the surrounding air, but the loss of efficiency caused by this unresisted expansion is justified by the practical difficulties involved in recovering it the engine would have to be much larger. After the opening of the exhaust valve, the exhaust stroke follows, but this and the following induction stroke are not shown on the diagram. If shown, they would be represented by a low-pressure loop at the bottom of the diagram. At 1 it is assumed that the exhaust and induction strokes have been completed, and the cylinder is again filled with air. The piston-cylinder system absorbs energy between 1 and 2â€”this is the work needed to compress the air in the cylinder, and is provided by mechanical kinetic energy stored in the flywheel of the engine. Work output is done by the piston-cylinder combination between 2 and 4. The difference between these two increments of work is the indicated work output per cycle, and is represented by the area enclosed by the pâ€”V loop. The adiabatic expansion is in a higher pressure range than that of the compression because the gas in the cylinder is hotter during expansion than during compression. It is for this reason that the loop has a finite area, and the net output of work during a cycle is positive. Major advantages[edit] Diesel engines have several advantages over gasoline-powered engines: Diesel fuel has higher energy density and a smaller volume of fuel is required to perform a specific amount of work. Diesel engines inject the fuel directly into the combustion chamber, have no intake air restrictions apart from air filters and intake plumbing and have no intake manifold vacuum to add parasitic load and pumping losses resulting from the pistons being pulled downward against intake system vacuum. Cylinder filling with atmospheric air is aided and volumetric efficiency is increased for the same reason. Heavier fuels like diesel fuel have higher cetane ratings and lower octane ratings, resulting in increased tendency to ignite spontaneously and burn completely in the cylinders when injected.

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Chapter 2 : How the ignition system works | How a Car Works

In a diesel engine, ignition is achieved by compression of air alone. A typical compression ratio for a diesel engine is , compared with for a petrol engine. Compressions as great as this heat up the air to a temperature high enough to ignite the fuel spontaneously, with no need of a spark and therefore of an ignition system.

Distributor The coil is the component that produces this high voltage. It is an electromagnetic device that converts the low-tension LT current from the battery to high-tension HT current each time the distributor contact-breaker points open. The distributor unit consists of a metal bowl containing a central shaft, which is usually driven directly by the camshaft or, sometimes, by the crankshaft. The bowl houses the contact-breaker points, rotor arm, and a device for altering the ignition timing. It also carries the distributor cap. Distributing the current The distributor cap is made of nonconductive plastic, and the current is fed to its central electrode by the HT lead from the centre of the coil. Inside the cap there are more electrodes often called segments to which the sparkplug leads are connected, one per cylinder. The rotor arm is fitted on top of the central shaft, and connects to the central electrode by means of a metal spring or spring-loaded brush in the top of the distributor cap. The current enters the cap through the central electrode, passes to the centre of the rotor arm through the brush, and is distributed to each plug as the rotor arm revolves. As the rotor arm approaches a segment, the contact-breaker points open and HT current passes through the rotor arm to the appropriate sparkplug lead. The contact-breaker points are mounted inside the distributor. They act as a switch , in synchronisation with the engine, that cuts off and reconnects the 12 volt low-tension LT circuit to the coil. The points are opened by cams on the central shaft, and are closed again by a spring arm on the moving contact. With the points closed, LT current flows from the battery to the primary windings in the coil, and then to earth through the points. When the points open, the magnetic field in the primary winding collapses and high-tension HT current is induced in the secondary windings. This current is transferred to the sparkplugs through the distributor cap. On a four-cylinder engine there are four cams. With each full rotation of the shaft the points open four times. Six-cylinder engines have six cams and six electrodes in the cap. This alters the timing of the spark to obtain an exact setting see How engine timing works. Further changes occur automatically as the engine speed varies according to the throttle opening. In some modern ignition systems, micro-electronics ensure the optimum ignition timing for all engine speeds and engine load conditions see How engine timing works.

Chapter 3 : Woodward | Engine Ignition Systems

An ignition system generates a spark or heats an electrode to a high temperature to ignite a fuel-air mixture in spark ignition internal combustion engines, oil-fired and gas-fired boilers, rocket engines, etc. The widest application for spark ignition internal combustion engines is in petrol (gasoline) road vehicles: cars and motorcycles.

Ignition magneto The simplest form of spark ignition is that using a magneto. The engine spins a magnet inside a coil, or, in the earlier designs, a coil inside a fixed magnet, and also operates a contact breaker , interrupting the current and causing the voltage to be increased sufficiently to jump a small gap. The spark plugs are connected directly from the magneto output. Early magnetos had one coil, with the contact breaker sparking plug inside the combustion chamber. In about , Bosch introduced a double-coil magneto, with a fixed sparking plug, and the contact breaker outside the cylinder. Magnetos are not used in modern cars, but because they generate their own electricity they are often found on small engines such as those found in mopeds , lawnmowers , snowblowers , chainsaws , etc. They are also used on piston-engined aircraft engines. Although an electrical supply is available, magneto systems are used mainly because of their higher reliability. Magnetos were used in these engines because their simplicity and self-contained operation was more reliable, and because magnetos weighed less than having a battery and dynamo or alternator. Aircraft engines usually have dual magnetos to provide redundancy in the event of a failure, and to increase efficiency by thoroughly and quickly burning the fuel air mix from both sides towards the center. The Wright brothers used a magneto invented in and built for them in by Dayton, Ohio inventor, Vincent Groby Apple. This gave the benefits of easy starting from the battery system with reliable sparking at speed from the magneto. Many modern magneto systems except for small engines have removed the second high voltage coil from the magneto itself and placed it in an external coil assembly similar to the ignition coil described below. In this development, the induced current in the coil in the magneto also flows through the primary of the external coil, generating a high voltage in the secondary as a result. Energy transfer systems provide the ultimate in ignition reliability. Switchable systems[edit] Switchable magneto ignition circuit, with starting battery. The output of a magneto depends on the speed of the engine, and therefore starting can be problematic. Some magnetos include an impulse system, which spins the magnet quickly at the proper moment, making easier starting at slow cranking speeds. Some engines, such as aircraft but also the Ford Model T , used a system which relied on non rechargeable dry cells , similar to a large flashlight battery, and which was not maintained by a charging system as on modern automobiles to start the engine or for starting and running at low speed. The operator would manually switch the ignition over to magneto operation for high speed operation. With this apparatus, the direct current passes through an electromagnetic coil which pulls open a pair of contact points, interrupting the current; the magnetic field collapses, the spring-loaded points close again, the circuit is reestablished, and the cycle repeats rapidly. In this mode of operation, the coil would "buzz" continuously, producing a constant train of sparks. Long after the demise of the Model T as transportation they remained a popular self-contained source of high voltage for electrical home experimenters, appearing in articles in magazines such as Popular Mechanics and projects for school science fairs as late as the early s. In the UK these devices were commonly known as trembler coils and were popular in cars pre, and also in commercial vehicles with large engines until around to ease starting. The Model T built into the flywheel differed from modern implementations by not providing high voltage directly at the output; the maximum voltage produced was about 30 volts, and therefore also had to be run through the spark coil to provide high enough voltage for ignition, as described above, although the coil would not "buzz" continuously in this case, only going through one cycle per spark. This performed the equivalent function to the modern distributor , although by directing the low voltage, not the high voltage as for the distributor. The timing of the spark was adjustable by rotating this mechanism through a lever mounted on the steering column. However, for the low speed and the low compression of such early engines, this imprecise timing was acceptable. Battery and coil-operated ignition[edit] Main article: Inductive discharge ignition With the universal adoption of electrical starting for automobiles, and the availability of a large battery to provide a constant source of electricity, magneto systems were abandoned for systems which interrupted current at battery voltage, using an ignition coil to step the voltage up to the needs of the ignition, and a distributor to route the ensuing pulse to the correct spark plug at the correct time. A trembler coil was a battery-powered induction coil ; the trembler interrupted the current through the coil and caused a quick series of sparks during each firing. The trembler coil would be energized at an appropriate point in the engine cycle. In the Model T, the four-cylinder engine had a trembler coil for each cylinder; a commutator timer case delivered power to the trembler coils. The Model T would be started on battery but then switched to an alternator. Delco and introduced in the Cadillac. This ignition was developed by Charles Kettering and was a wonder in its day. It consisted of a single ignition coil, points the switch , a capacitor to prevent the points from arcing at break and a distributor to direct the spark from the ignition coil to the correct cylinder. The points allow the coil magnetic field to build. When the points open by a cam arrangement, the magnetic field collapses inducing an EMF in the primary that is much larger than the battery voltage and the transformer action produces a large output voltage 20 kV or greater from the secondary. The capacitor suppresses arcing at the points when they open; without the capacitor, the energy stored in the coil would be expended at an arc across the points rather than at the spark plug gap. The Kettering system became the primary ignition system for many years in the automotive industry due to its lower cost, and relative simplicity. Modern ignition systems[edit] The ignition system is typically controlled by a key operated Ignition switch. Mechanically timed ignition[edit] Top of distributor cap with wires and terminals Rotor contacts inside distributor cap Most four-stroke engines have used a mechanically timed electrical ignition system. The heart of the system is the distributor. External to the distributor is the ignition coil , the spark plugs and wires linking the distributor to the spark plugs and ignition coil. The engine operates contact breaker points, which interrupt the current to an induction coil known as the ignition coil. The ignition coil consists of two transformer windings â€” the primary and secondary. These windings share a common magnetic core. An alternating current in the primary induces an alternating magnetic field in the core and hence an alternating current in the secondary. This is a step-up transformer, which produces a high voltage from the secondary winding. The primary winding is connected to the battery usually through a current-limiting ballast resistor. Inside the ignition coil one end of each winding is connected together. Ignition circuit diagram for mechanically timed ignition The ignition firing sequence begins with the points or contact breaker closed. A steady current flows from the battery, through the current-limiting resistor, through the primary coil, through the closed breaker points and finally back to the battery. This magnetic field forms the energy reservoir that will be used to drive the ignition spark. As the engine crankshaft turns, it also turns the distributor shaft at half the speed. In a four-stroke engine, the crankshaft turns twice for the ignition cycle. A multi-lobed cam is attached to the distributor shaft; there is one lobe for each engine cylinder. A spring-loaded rubbing block follows the lobed portions of the cam contour and controls the opening and closing of points. Opening the points causes the current through the primary coil to stop. Without the steady current through the primary, the magnetic field generated in the coil immediately collapses. The spark generation story is a little more complicated. At the moment the points open, there is a much smaller gap, say about 0. Something must be done to prevent the points from arcing as they separate; if the points arc, then they will drain the magnetic energy that was intended for the spark plug. The capacitor condenser performs that task. There is a race: Ultimately, the point separation will increase to something such as 0. In addition to staying below the arcing voltage, the ignition system keep the voltage across the points below the breakdown voltage for an air gap to prevent a glow discharge across the points. Such a glow discharge would quickly transition to an arc, and the arc would prevent the spark plug from firing. Keeping the points from arcing when they separate is the reason the ignition coil includes a secondary winding rather than using just a simple inductor. If the transformer has a Surrounding the rotor is the distributor cap. The arrangement sequentially directs the output of the secondary winding to the appropriate spark plugs. Some two-cylinder motorcycles and motor scooters had two contact points feeding twin coils each connected directly to one of the two sparking plugs without a distributor; e. High performance engines with eight or more cylinders that operate at high r. This problem is overcome by using either of these adaptations: Two complete sets of coils, breakers and condensers can be provided - one set for each half of the engine, which is typically arranged in V-8 or V configuration. Although the two ignition system halves are electrically independent, they typically share a single distributor which in this case contains two breakers driven by the rotating cam, and a rotor with two isolated conducting planes for the two high voltage inputs. A single breaker driven by a cam and a return spring is limited in spark rate by the onset of contact bounce or float at high rpm. Each breaker then switches current flow at half the rate of a single breaker and the "dwell" time for current buildup in the coil is maximized since it is shared between the breakers, one contact set being the "make" pair and the second being the "break" pair. The Lamborghini V-8 engine has both these adaptations and therefore uses two ignition coils and a single distributor that contains 4 contact breakers. A distributor-based system is not greatly different from a magneto system except that more separate elements are involved. There are also advantages to this arrangement. For example, the position of the contact breaker points relative to the engine angle can be changed a small amount dynamically, allowing the ignition timing to be automatically advanced with increasing revolutions per minute RPM or increased manifold vacuum , giving better efficiency and performance. However it is necessary to check periodically the maximum opening gap of the breaker s , using a feeler gauge, since this mechanical adjustment affects the "dwell" time during which the coil charges, and breakers should be re-dressed or replaced when they have become pitted by electric arcing. This system was used almost universally until the l, when electronic ignition systems started to appear. Electronic ignition[edit] The disadvantage of the mechanical system is the use of breaker points to interrupt the low-voltage high-current through the primary winding of the coil; the points are subject to mechanical wear where they ride the cam to open and shut, as well as oxidation and burning at the contact surfaces from the constant sparking. They require regular adjustment to compensate for wear, and the opening of the contact breakers, which is responsible for spark timing , is subject to mechanical variations. In addition, the spark voltage is also dependent on contact effectiveness, and poor sparking can lead to lower engine efficiency. A mechanical contact breaker system cannot control an average ignition current of more than about 3 A while still giving a reasonable service life, and this may limit the power of the spark and ultimate engine speed. Example of a basic electronic ignition system. Electronic ignition EI solves these problems. In the initial systems, points were still used but they handled only a low current which was used to control the high primary current through a solid state switching system. Soon, however, even these contact breaker points were replaced by an angular sensor of some kind - either optical , where a vaned rotor breaks a light beam, or more commonly using a Hall effect sensor , which responds to a rotating magnet mounted on the distributor shaft. The sensor output is shaped and processed by suitable circuitry, then used to trigger a switching device such as a thyristor , which switches a large current through the coil. The first electronic ignition a cold cathode type was tested in by Delco-Remy , [3] while Lucas introduced a transistorized ignition in , which was used on BRM and Coventry Climax Formula One engines in Ford fitted a Lucas system on the Lotus 25s entered at Indianapolis the next year, ran a fleet test in , and began offering optional EI on some models in The lack of moving parts compared with the mechanical system leads to greater reliability and longer service intervals. Chrysler introduced breakerless ignition in mid as an option for its V8 and the Street Hemi.

Chapter 4 : diesel engine | Definition, Development, Types, & Facts | calendrierdelascience.com

Diesel engine: Diesel engine, any internal-combustion engine in which air is compressed to a sufficiently high temperature to ignite diesel fuel injected into the cylinder, where combustion and expansion actuate a piston.

Since ignition systems are made up of a number of different components, a lot of different moving parts had to come together before they could be developed. One of the earliest examples of some of the major principles utilized by spark-ignition systems dates back to , when Alessandro Volta built a toy electric pistol that used an electric spark to ignite a mixture of hydrogen and air to shoot a cork. Although Alessandro Volta demonstrated how an electric spark could be used to drive what essentially amounted to a piston, two major components had to be invented before the ignition system could be developed. The first component was the magneto, which is a device that uses magnets to generate an electric current. Another watershed moment in the history of the ignition system was invention of the spark plug in This component, which is ubiquitous in modern spark-ignited internal combustion engines, was developed by Belgian engineer Etienne Lenoir for his gasoline engine. At around the turn of the century, Rudolph Diesel developed the Diesel cycle. This resulted in the development of a completely different type of ignition system that sometimes utilizes components like glow plugs to assist in ignition. In the early years of the 20th century, basic magneto ignition systems were developed into switchable systems. These systems were manually switchable from using replaceable dry cell batteries to start an engine and run it at low speeds to using magneto ignition at higher speeds. The next major development in the history of the ignition system came in , when Cadillac introduced an engine that utilized a battery and coil type ignition. This system had all of the same basic parts that were used for over half a century, including a battery-operated coil, a capacitor, points, and a distributor. Like modern ignition systems, the coil generated the current necessary to induce a spark, the points acted as the switch to trigger the coil, and the distributor sent the spark to the proper cylinder at the necessary time. Modern ignition systems use electronic ignition instead of mechanical devices like points. One of the first instances of an electronic ignition system was offered by Pontiac in , and the first solid state system also showed up that year. Coil on plug ignition systems are a relatively recent development in the history of the ignition system. The next major development was the introduction of electronically controlled ignition systems. These systems started to gain in popularity during the s, and they are now used throughout the automotive industry. Instead of using a distributor to route current from a single coil, these systems use computer-controlled coil packs that are each connected to either one or two spark plugs. Ignition System Components Since there are a few different types of ignition systems, not every engine has the same ignition system components. The two main types of ignition systems are spark-ignition and compression ignition, and there are also a number of different types of spark-ignited systems. Magneto-type Ignition System Components Magneto-type ignition system components typically include: These systems were popular in the early days of the automobile, but they are no longer used in automotive applications. Small engines, like those found in lawn mowers, often use these systems due to the fact that no battery is required for the ignition process. Switchable Ignition System Components Switchable systems are hybrids, so they typically included: One of the main drawbacks of magneto ignition systems is that the timing is fixed. In order to help deal with that situation, while not giving up the perceived reliability of the magneto, some vehicles were equipped with switchable systems. These ignition systems were hybrids of magneto and coil ignition, and they typically allowed the driver to switch over from coil to magneto after the vehicle was already started up and moving.

Chapter 5 : S/S Machine & Engineering, LLC

Mechanical ignition Most four-stroke engines have used a mechanically timed electrical ignition system. The heart of the system is the distributor which contains a rotating cam running off the engine's drive, a set of breaker points, a.

Experiments with diesel-engine locomotives and railcars began almost as soon as the diesel engine was patented by the German engineer Rudolf Diesel in Attempts at building practical locomotives and railcars for branch-line passenger runs continued through the s. The first successful dieselâ€¦ Diesel combustion The diesel engine is an intermittent-combustion piston-cylinder device. It operates on either a two-stroke or four-stroke cycle see figure ; however, unlike the spark-ignition gasoline engine , the diesel engine induces only air into the combustion chamber on its intake stroke. Diesel engines are typically constructed with compression ratios in the range Both two-stroke and four-stroke engine designs can be found among engines with bores cylinder diameters less than mm 24 inches. Engines with bores of greater than mm are almost exclusively two-stroke cycle systems. Four-stroke diesel engineThe typical sequence of cycle events involves a single intake valve, fuel-injection nozzle, and exhaust valve, as shown here. Injected fuel is ignited by its reaction to compressed hot air in the cylinder, a more efficient process than that of the spark-ignition internal-combustion engine. The diesel engine gains its energy by burning fuel injected or sprayed into the compressed, hot air charge within the cylinder. The air must be heated to a temperature greater than the temperature at which the injected fuel can ignite. Diesel engines are sometimes called compression-ignition engines because initiation of combustion relies on air heated by compression rather than on an electric spark. In a diesel engine, fuel is introduced as the piston approaches the top dead centre of its stroke. The fuel is introduced under high pressure either into a precombustion chamber or directly into the piston-cylinder combustion chamber. With the exception of small, high-speed systems, diesel engines use direct injection. Diesel engine fuel-injection systems are typically designed to provide injection pressures in the range of 7 to 70 megapascals 1, to 10, pounds per square inch. There are, however, a few higher-pressure systems. Precise control of fuel injection is critical to the performance of a diesel engine. Since the entire combustion process is controlled by fuel injection, injection must begin at the correct piston position i. At first the fuel is burned in a nearly constant-volume process while the piston is near top dead centre. As the piston moves away from this position, fuel injection is continued, and the combustion process then appears as a nearly constant-pressure process. The combustion process in a diesel engine is heterogeneousâ€”that is, the fuel and air are not premixed prior to initiation of combustion. Consequently, rapid vaporization and mixing of fuel in air is very important to thorough burning of the injected fuel. This places much emphasis on injector nozzle design, especially in direct-injection engines. Engine work is obtained during the power stroke. The power stroke includes both the constant-pressure process during combustion and the expansion of the hot products of combustion after fuel injection ceases. Diesel engines are often turbocharged and aftercooled. Addition of a turbocharger and aftercooler can enhance the performance of a diesel engine in terms of both power and efficiency. The most outstanding feature of the diesel engine is its efficiency. By compressing air rather than using an air-fuel mixture, the diesel engine is not limited by the preignition problems that plague high-compression spark-ignition engines. Thus, higher compression ratios can be achieved with diesel engines than with the spark-ignition variety; commensurately, higher theoretical cycle efficiencies , when compared with the latter, can often be realized. It should be noted that for a given compression ratio the theoretical efficiency of the spark-ignition engine is greater than that of the compression-ignition engine; however, in practice it is possible to operate compression-ignition engines at compression ratios high enough to produce efficiencies greater than those attainable with spark-ignition systems. Furthermore, diesel engines do not rely on throttling the intake mixture to control power. As such, the idling and reduced-power efficiency of the diesel is far superior to that of the spark-ignition engine. The principal drawback of diesel engines is their emission of air pollutants. These engines typically discharge high levels of particulate matter soot , reactive nitrogen compounds commonly designated NOx , and odour compared with spark-ignition engines. Consequently, in the small-engine category, consumer acceptance is low. A diesel engine is started by driving it from some external power source until conditions have been established under which the engine can run by its own power. The simplest starting method is to admit air from a high-pressure sourceâ€”about 1. The compressed air becomes heated sufficiently to ignite the fuel. The selection of the most suitable starting method depends on the physical size of the engine to be started, the nature of the connected load, and whether or not the load can be disconnected during starting. Major types of diesel engines Three basic size groups There are three basic size groups of diesel engines based on powerâ€”small, medium, and large. The small engines have power-output values of less than kilowatts, or horsepower. This is the most commonly produced diesel engine type. These engines are used in automobiles , light trucks , and some agricultural and construction applications and as small stationary electrical-power generators such as those on pleasure craft and as mechanical drives. They are typically direct-injection, in-line, four- or six-cylinder engines. Many are turbocharged with aftercoolers. Medium engines have power capacities ranging from to kilowatts, or to 1, horsepower. The majority of these engines are used in heavy-duty trucks. They are usually direct-injection, in-line, six-cylinder turbocharged and aftercooled engines. Some V-8 and V engines also belong to this size group. Large diesel engines have power ratings in excess of kilowatts. These unique engines are used for marine, locomotive, and mechanical drive applications and for electrical-power generation. In most cases they are direct-injection, turbocharged and aftercooled systems. They may operate at as low as revolutions per minute when reliability and durability are critical. Two-stroke and four-stroke engines As noted earlier, diesel engines are designed to operate on either the two- or four-stroke cycle. In the typical four-stroke-cycle engine, the intake and exhaust valves and the fuel-injection nozzle are located in the cylinder head see figure. Often, dual valve arrangementsâ€”two intake and two exhaust valvesâ€”are employed. Use of the two-stroke cycle can eliminate the need for one or both valves in the engine design. Scavenging and intake air is usually provided through ports in the cylinder liner. Exhaust can be either through valves located in the cylinder head or through ports in the cylinder liner. Engine construction is simplified when using a port design instead of one requiring exhaust valves. Fuel for diesels Petroleum products normally used as fuel for diesel engines are distillates composed of heavy hydrocarbons , with at least 12 to 16 carbon atoms per molecule. These heavier distillates are taken from crude oil after the more volatile portions used in gasoline are removed. Thus, their evaporation temperature is much higher than that of gasoline, which has fewer carbon atoms per molecule. Grade Low Sulfur No. It is also suitable for use in non-automotive applications, especially in conditions of varying speed and load. Water and sediment in fuels can be harmful to engine operation; clean fuel is essential to efficient injection systems. Fuels with a high carbon residue can be handled best by engines of low-speed rotation. The same applies to those with high ash and sulfur content. Diesel realized that the electric ignition process of the gasoline engine could be eliminated if, during the compression stroke of a piston-cylinder device, compression could heat air to a temperature higher than the auto-ignition temperature of a given fuel. Diesel proposed such a cycle in his patents of and Originally, either powdered coal or liquid petroleum was proposed as fuel. Diesel saw powdered coal, a by-product of the Saar coal mines, as a readily available fuel. Compressed air was to be used to introduce coal dust into the engine cylinder; however, controlling the rate of coal injection was difficult, and, after the experimental engine was destroyed by an explosion, Diesel turned to liquid petroleum. He continued to introduce the fuel into the engine with compressed air. The engine operated successfully for years and was the forerunner of the Busch-Sulzer engine that powered many submarines of the U. Navy in World War I. The diesel engine became the primary power plant for submarines during World War I. It was not only economical in the use of fuel but also proved reliable under wartime conditions. Diesel fuel, less volatile than gasoline, was more safely stored and handled. At the end of the war many men who had operated diesels were looking for peacetime jobs. Manufacturers began to adapt diesels for the peacetime economy. One modification was the development of the so-called semidiesel that operated on a two-stroke cycle at a lower compression pressure and made use of a hot bulb or tube to ignite the fuel charge. These changes resulted in an engine less expensive to build and maintain. Fuel-injection technology One objectionable feature of the full diesel was the necessity of a high-pressure, injection air compressor. Not only was energy required to drive the air compressor, but a refrigerating effect that delayed ignition occurred when the compressed air , typically at 6. Diesel had needed high-pressure air with which to introduce powdered coal into the cylinder; when liquid petroleum replaced powdered coal as fuel, a pump could be made to take the place of the high-pressure air compressor. There were a number of ways in which a pump could be used. In England the Vickers Company used what was called the common-rail method, in which a battery of pumps maintained the fuel under pressure in a pipe running the length of the engine with leads to each cylinder. From this rail or pipe fuel-supply line, a series of injection valves admitted the fuel charge to each cylinder at the right point in its cycle. Another method employed cam-operated jerk, or plunger-type, pumps to deliver fuel under momentarily high pressure to the injection valve of each cylinder at the right time. The elimination of the injection air compressor was a step in the right direction, but there was yet another problem to be solved: Engineers finally realized that the problem was that the momentarily high-pressure injection air exploding into the engine cylinder had diffused the fuel charge more efficiently than the substitute mechanical fuel nozzles were able to do, with the result that without the air compressor the fuel had to search out the oxygen atoms to complete the combustion process, and, since oxygen makes up only 20 percent of the air, each atom of fuel had only one chance in five of encountering an atom of oxygen. The result was improper burning of the fuel. The usual design of a fuel-injection nozzle introduced the fuel into the cylinder in the form of a cone spray, with the vapour radiating from the nozzle, rather than in a stream or jet. Very little could be done to diffuse the fuel more thoroughly. Improved mixing had to be accomplished by imparting additional motion to the air, most commonly by induction-produced air swirls or a radial movement of the air, called squish, or both, from the outer edge of the piston toward the centre. Various methods have been employed to create this swirl and squish.

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Chapter 6 : How a Car Ignition System Works | YourMechanic Advice

The ignition system's part in this process takes place way before producing the spark and involves a selection of systems designed to facilitate the spark-producing process. Spark Plugs and Wires The electric charge from the battery, via the starter solenoid, ignites the fuel/air mixture in the combustion chamber.

Starting a vehicle involves much more than just turning a key in the ignition switch; it requires each system to work in unison to start a vehicle. After turning the key, the process to ignite the fuel and power the engine begins. A Matter of Timing Every system in an engine is set up to work at a precise time in the combustion process. When this process does not work properly, the engine becomes subjected to misfires, decreased power, and lower fuel efficiency. After turning the key, the starter solenoid engages, allowing the power surge from the battery to reach the spark plugs via the spark plug wires. Each chamber holds a single spark plug that receives the electricity to spark through the spark plug wires. You need to keep both the spark plugs and wires in good shape or the vehicle can suffer from misfires, poor power and performance, and worsening gas mileage. You must also make sure a mechanic properly gaps the spark plugs before installing them into the vehicle. A spark is produced as the electric current jumps the gap. Improperly gapped spark plugs cause engines to run poorly. Other problem areas when it comes to spark plugs include the buildup of deposits on the electrode area. The make and model of the vehicle helps determine whether it uses cold or hot plugs. Hot plugs burn hotter and thus burn off more of these deposits. Cold plugs come into play in high-performance engines. A good way to identify a spark plug wire that needs replacing is to start the vehicle in a dark area. While the engine runs, examine the wires running from the spark plug to the distributor cap. The dim lighting will allow you to see any out of place sparks in the system; tiny electric arcs commonly jump from the cracks and breaks in worn spark plug wires. Raising the Voltage With the Ignition Coil Electric voltage from the battery first passes through the ignition coil on its way to the spark plugs. Amplifying this low-voltage charge is the main purpose of the ignition coil. Current flows along the primary coil, one of two sets of wound wire found within the ignition coil. Also, wrapped around the primary coil, you find the secondary coil, which contains hundreds more turns than the primary coil. Breaker points disrupt the flow of the current through the primary coil, causing the magnetic field in the coil to collapse, and produce a magnetic field in the secondary coil. This process creates a high-voltage electric current which feeds into the distributor and on to the spark plugs. The Function of the Rotor and Distributor Cap The distributor uses a cap and rotor system to distribute the high-voltage charge to the correct cylinder. The rotor spins, distributing the charge to each cylinder as it passes the contact for each. Current arcs across the small gap between the rotor and the contact as they pass one another. Unfortunately, the high heats produced during the passage of the charge can cause a distributor to wear out, especially the rotor. When performing a tune-up on an older vehicle, a mechanic will usually replace the rotor and distributor cap as a part of the process. Engines Without a Distributor Newer vehicles forego the use of a central distributor and instead utilize a coil on each spark plug. Connected directly to the engine computer, or Engine Control Unit ECU , this affords the vehicle control system more accurate control over the timing of the spark plug. This system eliminates the need for a distributor and spark plug wires since the ignition system applies the charge at the plug. This setup gives a vehicle better fuel efficiency, reduced emissions, and more overall power. Diesel Engines and Glow Plugs Unlike a gasoline engine, diesel engines use a glow plug, instead of a spark plug, to preheat the combustion chamber prior to firing.

Chapter 7 : Ignition systems: Which are the 4 Ignition Systems used in I. C. Engine

How Car Engines Work In this article, we'll learn about ignition systems, starting with spark timing. Then we'll look at all of the components that go into making the spark, including spark plugs, coils and distributors.

Ignition points must lineup correctly when they are closed. Test resistance of coil with multi-meter set on Ohms. Test battery ground connection with a multi-meter set on volts D. Testing for a short at the points with a multi-meter set on continuity. Testing the ignition switch with a multi-meter set on volts D. Meter should show 12 to 13 volts. Figure 4 Breaker point ignition systems were, until the advent of electronic ignition systems, used on millions of engines. From the engines powering rum runners of the s to all those Jeeps in World War II, all of them had breaker point ignition systems. Breaker Point Basics The breaker point ignition system circuit starts and ends with the battery. When the engine is running the battery is continuously being recharged by an alternator or, on older systems, a generator. Current flows from the positive terminal of the battery to the ignition switch and an ignition coil. The ignition coil is really a transformer that steps up the volt current of the battery to somewhere in the neighborhood of 25, volts. The coil has two circuits in it; the primary, which runs from the positive coil terminal to the negative coil terminal; and the secondary circuit, which goes from the positive terminal on the coil to the ignition wire in the center of the distributor cap. The negative wire on the primary circuit runs from the coil to the base of the distributor and the breaker points inside. This may sound a little confusing, but it makes sense when you understand that the points act to open and close the ground circuit. The breaker points open and close as the distributor shaft rotates. One half of the point set is fixed, the other half pivots and there is a rubbing block on the moveable half of the point set. The distributor shaft has lobes that contact the rubbing block. These lobes act as cams to push the points open, thereby breaking the electrical connection between the points. The points have a spring clip that acts to hold the points shut, and this spring causes the moveable point to snap back into contact with the stationary point mounted to the distributor plate when the cam rotates out of contact. If this is unclear, take the distributor cap off of a breaker point-equipped engine and rotate the engine manually, watching the parts move. The interplay will become obvious. When the points are touching each other electricity runs from the battery, through the coil and to the engine block, which is grounded to the negative terminal on the battery. The current running through the windings in the ignition coil builds up a powerful electrical field that is unleashed when the points separate. No longer able to go to ground through the points, the electricity, which is seeking the easiest path to ground, rushes through the secondary circuit to the coil wire to the top of the distributor cap where it is transmitted to the distributor rotor. The rotor is fixed to the top of the distributor shaft and revolves around the inside of the distributor, its contact giving each post on the circumference of the distributor cap a shot of electricity as it passes by. Continue Reading The spark has to be timed so that it sets off the gas at the right part of the piston cycle, usually when the piston is near the top of the cylinder. On most engines ignition timing is set by loosening a distributor hold down bolt and rotating the distributor to advance or retard the spark timing. Old-time garage jockeys used to set timing by ear, turning the distributor until the engine sounded "right. The light is aimed at one of the pulleys on the front of the engine and the distributor is rotated until a notch on the pulley lines up with a mark on the pulley guard. Troubleshooting Knowing how a breaker point system works puts you in a much better position to repair it when it breaks down. Push down hard on the boots at the end of the spark plug wires to make sure that they are on securely. Take a glance at the points; if they look corroded replace them. Check the gap between the points the space formed when the points are at their widest open setting with a feeler gauge, getting the proper specification for the gap from a repair manual. A typical setting is 0. Use a socket and a breaker bar to rotate the engine so that the points are at their widest gap. The gauge, either a wire type or feeler type, should just slide between the points without pushing them apart. Test the battery with a voltmeter and a hydrometer. You want the battery to read at least If the battery needs to be recharged make sure to use a trickle charger, a charger that runs at no more than 2 amps. High amp chargers can ruin a battery if used often,, something I had to learn the hard way. Double-check the battery with a hydrometer. Be sure to wear splash-proof goggles. Each cell should read almost the same as the others. If you get a drastically different reading in one cell you may have a bad battery. Use the voltmeter to take a reading at the ends of the battery cables. The voltage should be the same as at the battery itself. If not, clean the ends of the cables and try again. If you still get a voltage drop at the end of the cables, junk them and get new cables. While you are at it, try wiggling the cables around with the voltmeter probes firmly attached. If you see a low or nonexistent reading you have a cable that is corroded on the inside. Assuming you have a good battery that is fully charged, good battery cables and clean, tight connections you can start testing other parts of the circuit. Place the positive probe of the test meter on the positive battery terminal and the negative probe on a clean part of the engine block. This tests the ground connection between the negative battery terminal and the block. If you find a significant drop in voltage, stop to check for a bad connection or wire. Some engines have an external resistor near the ignition coil. This will affect the voltage reading you get according to the strength of the resistor. You can check the resistor with an ohmmeter. Get the resistance of the resistor from the manual for your engine some resistors may have their ohm rating marked on them. The coil can be checked the same way. Use your voltmeter to check for a short to ground between the battery and the points. Block the points open with a small piece of wood and put one probe on the appropriate battery terminal and the other probe on the point itself. Just make sure that you have your polarities straight. With the points blocked open one will be positive, the other negative. Test for continuity between the block and the negative coil terminal to confirm this theory. Test for continuity between the block and the stationary point attached to the distributor plate. Rotate the engine until the points are closed. Use the multi-meter to test for a good connection between the points. A slight gap when the points are supposed to be closed will keep your machine from running. If you do not have a test meter you can use a self-powered test light to do essentially the same thing. Always use the test light with the battery disconnected. When the circuit is closed the light will shine. If you have a fault in the circuit, such as a broken wire, the light will not come on. Starting at the battery cables go around the circuit testing each wire and connection. Block the points open and place each probe on one of the points. If the light goes on you have found the problem. Look carefully to find the bare patch of insulation or missing rubber washer on the distributor wire. With the points touching and the probes on each point the light should shine for you. You can file them down, or better yet replace them. It is a good idea to replace the point condenser at the same time. The condenser is usually located inside the distributor, but sometimes is attached to the outside housing. It has a single lead that attaches to the points where the negative wire from the ignition coil attaches. Any spark plugs wires with cracked insulation should be replaced. Use your multi-meter to test the spark plugs. There should be continuity between the top of the plug and the electrode. Put the end of the plug in the boot on the end of the ignition wire and test for continuity between the electrode and the end of the plug wire. This will rule out a bad plug wire or a bad connection between plug and wire. These are usually the first parts that get replaced when someone is going over the ignition system. If they look old or damaged, I would replace them. Contact engine enthusiast Gary Grinnell at: Working on a Pay loader, 4 cylinder flathead engine. I believe it is a Continental engine. It has an alternator on it with one insulated bold on the back that i believe the positive battery cable connects to it from the positive side of the starter relay. Then there is a plug on the side of the alternator that has A 2 wire connector that plugs into it.. I dont know where these wires go???? Also im not sure if i got the correct wire going to the insulated bolt on the alternator..

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Chapter 8 : Diesel engine - Wikipedia

A diesel engine needs to rotate between and rpm to start. the purpose of the starting system is to provide the torque needed to achieve the necessary minimum cranking.

This leads to the main combustion chamber. With this design, the ideal combustion chamber shape is compromised. A direct injection engine does not have a swirl chamber into which the fuel is injected - the fuel goes straight into the combustion chamber instead. Engineers have to pay very careful attention to the design of the combustion chamber in the piston crown to ensure that it creates enough turbulence. Speed control Glow plugs Glow plugs To pre-heat the cylinder head and engine block before cold starts, the diesel uses glow plugs. Elements inside heat up very quickly once power is applied. Glow plugs are activated either by an auxiliary position on the steering column switch, or by a separate switch. On the latest designs they automatically switch themselves off once the engine has fired and is accelerated above idling speed. A diesel engine is not throttled like a petrol engine, so the amount of air sucked in at any particular engine speed is always the same. Engine speed is regulated purely by the amount of fuel squirted into the combustion chamber - with more fuel in the chamber, combustion is fiercer and more power is produced. The engine then only has to use a small amount of fuel before it comes to a halt. In fact, diesel engines come to rest more quickly than petrol engines because the much higher compression has a greater slowing-down effect on the engine. Starting a diesel As with petrol engines, diesel engines are started by being turned with an electric motor , which begins the compression-ignition cycle. When cold, however, diesel engines are difficult to start, simply because. To get around the problem, manufacturers fit glow plugs. Diesel fuel The fuel used in diesel engines is very different from petrol. It is slightly less refined, resulting in a heavier, more viscous and less volatile liquid. Diesel fuel can begin to stiffen slightly or even solidify in very cold weather. This is compounded by the fact that it can absorb very small quantities of water, which may freeze. All fuels absorb tiny amounts of water from the atmosphere and leakage into underground storage tanks is quite common. Diesel fuel can handle a water content of up to 50 or 60 parts in a million without problemsâ€”to put this into perspective this is about a quarter of a mug-full of water for every ten gallons of fuel. Stop wasting time on YouTube and get serious! The Ultimate 20 hour car mechanics video course Learn everything about modern cars from our new video series. Clearly and easily explained. All modeled in 3D.

Chapter 9 : Diesel Fuel Injection | HowStuffWorks

One big difference between a diesel engine and a gas engine is in the injection process. Most car engines use port injection or a carburetor. A port injection system injects fuel just prior to the intake stroke (outside the cylinder). A carburetor mixes air and fuel long before the air enters the.