PULSE JET ENGINE WORKING pdf

1: The Valveless Pulse Jet Engine - How does it work | Doovi

If you've ever wondered how pulsejet engines work, this video will explain the basics. If you want more information then the shameless plug at the end of the video will direct you to a site where.

Types[edit] There are two main types of pulsejet engines, both of which use resonant combustion and harness the expanding combustion products to form a pulsating exhaust jet which produces thrust intermittently. Valved pulsejets[edit] Valved pulsejet engines use a mechanical valve to control the flow of expanding exhaust, forcing the hot gas to go out of the back of the engine through the tailpipe only, and allow fresh air and more fuel to enter through the intake. The valved pulsejet comprises an intake with a one-way valve arrangement. The superheated exhaust gases exit through an acoustically resonant exhaust pipe. The intake valve is typically a reed valve. The two most common configurations are the daisy valve, and the rectangular valve grid. A daisy valve consists of a thin sheet of material to act as the reed, cut into the shape of a stylized daisy with "petals" that widen towards their ends. Each "petal" covers a circular intake hole at its tip. The daisy valve is bolted to the manifold through its centre. Although easier to construct on a small scale, it is less effective than a valve grid. Valveless pulsejet Valveless pulsejet engines have no moving parts and use only their geometry to control the flow of exhaust out of the engine. Valveless pulsejets expel exhaust out of both the intakes and the exhaust, though most try to have the majority of exhaust go out of the longer tail pipe for more efficient propulsion. Fuel, as a gas or atomized liquid spray, is either mixed with the air in the intake or directly injected into the combustion chamber. Starting the engine usually requires forced air and an ignition source, such as a spark plug, for the fuel-air mix. With modern manufactured engine designs, almost any design can be made to be self-starting by providing the engine with fuel and an ignition spark, starting the engine with no compressed air. Once running, the engine only requires input of fuel to maintain a self-sustaining combustion cycle. History[edit] Russian inventor and artillery officer N. Teleshov patented a pulsejet engine in while Swedish inventor Martin Wiberg also has a claim to having invented the first pulsejet, in Sweden, but details are unclear. The first working pulsejet was patented in by Russian engineer V. Karavodin, who completed a working model in The French inventor Georges Marconnet patented his valveless pulsejet engine in , and Ramon Casanova, in Ripoll , Spain patented a pulsejet in Barcelona in , having constructed one beginning in Robert Goddard invented a pulsejet engine in , and demonstrated it on a jet-propelled bicycle. Madelung co-invented the ribbon parachute , a device used to stabilise the V-1 in its terminal dive. The original Schmidt design had the pulsejet placed in a fuselage like a modern jet fighter, unlike the eventual V-1 which had the engine placed above the warhead and fuselage. Fritz Gosslau of Argus and the Siemens company, which were all combined to work on the V The pulsejet was evaluated to be an excellent balance of cost and function: The simple resonant design based on the ratio 8. The engine casing did not provide sufficient heat to cause diesel-type ignition of the fuel , as there is insignificant compression within a pulsejet engine. The Argus As valve array was based on a shutter system that operated at the 43 to 45 cycles-per-second frequency of the engine. Three air nozzles in the front of the Argus As were connected to an external high pressure source to start the engine. The fuel used for ignition was acetylene , with the technicians having to place a baffle of wood or cardboard in the exhaust pipe to stop the acetylene diffusing before complete ignition. Once the engine ignited and minimum operating temperature was attained, external hoses and connectors were removed. The V-1, being a cruise missile, lacked landing gear, instead the Argus As was launched on an inclined ramp powered by a piston -driven steam catapult. Steam power to fire the piston was generated by the violent exothermic chemical reaction created when hydrogen peroxide and potassium permanganate termed T-Stoff and Z-Stoff are combined. The principal military use of the pulsejet engine, with the volume production of the Argus As unit the first pulsejet engine ever in volume production , was for use with the V-1 flying bomb. Designers of modern cruise missiles do not choose pulsejet engines for propulsion, preferring turbojets or rocket engines. Wright Field technical personnel reverse-engineered the V-1 from the remains of one that had failed to detonate in Britain. While the thrust-to-weight ratio is excellent, thrust specific fuel consumption is very poor. This limits the maximum pre-combustion pressure ratio, to around 1.

The high noise levels usually make them impractical for other than military and other similarly restricted applications. Pulsejets have been used to power experimental helicopters, the engines being attached to the ends of the rotor blades. A helicopter may then be built without a tail rotor and its associated transmission and drive shaft, simplifying the aircraft cyclic and collective control of the main rotor is still necessary. This concept was being considered as early as when the American Helicopter Company started work on its XA-5 Top Sergeant helicopter prototype powered by pulsejet engines at the rotor tips. Hiller switched to tip mounted ramjets but American Helicopter went on to develop the XA-8 under a U. It first flew in and was known as the XH Jet Jeep. It used XPJ49 pulsejets mounted at the rotor tips. The XH met all its main design objectives but the Army cancelled the project because of the unacceptable level of noise of the pulsejets and the fact that the drag of the pulsejets at the rotor tips made autorotation landings very problematic. Variable intake geometry lets the engine produce full power at most speeds by optimizing for whatever speed the air is entering pulsejet at. Valveless designs are not as negatively affected by ram air pressure as other designs, as they were never intended to stop the flow out of the intake, and can significantly increase in power at speed. Another feature of pulsejet engines is that their thrust can be increased by a specially shaped duct placed behind the engine. The duct acts as an annular wing , which evens out the pulsating thrust, by harnessing aerodynamic forces in the pulsejet exhaust. The duct, typically called an augmenter, can significantly increase the thrust of a pulsejet with no additional fuel consumption. However, the larger the augmenter duct, the more drag it produces, and it is only effective within specific speed ranges. Function[edit] Pulsejet schematic. First part of the cycle: The combustion cycle comprises five or six phases depending on the engine: Starting with ignition within the combustion chamber, a high pressure is raised by the combustion of the fuel-air mixture. The pressurized gas from combustion cannot exit forward through the one-way intake valve and so exits only to the rear through the exhaust tube. The inertial reaction of this gas flow causes the engine to provide thrust, this force being used to propel an airframe or a rotor blade. The inertia of the traveling exhaust gas causes a low pressure in the combustion chamber. This pressure is less than the inlet pressure upstream of the one-way valve , and so the induction phase of the cycle begins. In the simplest of pulsejet engines this intake is through a venturi which causes fuel to be drawn from a fuel supply. In more complex engines the fuel may be injected directly into the combustion chamber. When the induction phase is under way, fuel in atomized form is injected into the combustion chamber to fill the vacuum formed by the departing of the previous fireball; the atomized fuel tries to fill up the entire tube including the tailpipe. This causes atomized fuel at the rear of the combustion chamber to "flash" as it comes in contact with the hot gases of the preceding column of gasâ€”this resulting flash "slams" the reed-valves shut or in the case of valveless designs, stops the flow of fuel until a vacuum is formed and the cycle repeats. Valved design[edit] There are two basic types of pulsejets. The first is known as a valved or traditional pulsejet and it has a set of one-way valves through which the incoming air passes. The cycle frequency is primarily dependent on the length of the engine. For a small model-type engine the frequency may be around pulses per second, whereas for a larger engine such as the one used on the German V-1 flying bomb , the frequency was closer to 45 pulses per second. The low-frequency sound produced resulted in the missiles being nicknamed "buzz bombs. Valveless pulsejet The second type of pulsejet is known as the valveless pulsejet. Valveless pulsejets come in a number of shapes and sizes, with different designs being suited for different functions. A typical valveless engine will have one or more intake tubes, a combustion chamber section, and one or more exhaust tube sections. The intake tube takes in air and mixes it with fuel to combust, and also controls the expulsion of exhaust gas, like a valve, limiting the flow but not stopping it altogether. While the fuel-air mixture burns, most of the expanding gas is forced out of the exhaust pipe of the engine. Because the intake tube s also expel gas during the exhaust cycle of the engine, most valveless engines have the intakes facing backwards so that the thrust created adds to the overall thrust, rather than reducing it. The combustion creates two pressure wave fronts, one traveling down the longer exhaust tube and one down the short intake tube. While some valveless engines are known for being extremely fuel-hungry, other designs use significantly less fuel than a valved pulsejet, and a properly designed system with advanced components and techniques can rival or exceed the fuel efficiency of small turbojet engines. In , Georges Marconnet developed the first pulsating combustor without valves. It was the grandfather of all valveless pulsejets. They can achieve higher top speeds, with some advanced designs being capable of operating at Mach 7[citation needed] possibly higher. The advantage of the acoustic-type pulsejet is simplicity. Since there are no moving parts to wear out, they are easier to maintain and simpler to construct. Future uses[edit] Pulsejets are used today in target drone aircraft, flying control line model aircraft as well as radio-controlled aircraft , fog generators, and industrial drying and home heating equipment. Because pulsejets are an efficient and simple way to convert fuel into heat, experimenters are using them for new industrial applications such as biomass fuel conversion, and boiler and heater systems. Some experimenters continue to work on improved designs. The engines are difficult to integrate into commercial manned aircraft designs because of noise and vibration, though they excel on the smaller-scale unmanned vehicles. The pulse detonation engine PDE marks a new approach towards non-continuous jet engines and promises higher fuel efficiency compared to turbofan jet engines, at least at very high speeds. Most PDE research programs use pulsejet engines for testing ideas early in the design phase.

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2: Pulsejet | Military Wiki | FANDOM powered by Wikia

In this video I describe simply the workings of Pulse Jet engines verses Ram Jet engines, and a concept for a Pulse to Ram engine that would change its design in flight to become a Ram Jet engine.

How do jet engines work? The simple answer is: A fuelmixture is then injected into a chamber with the compressed air andignited burn. The subsequent combustion is directed aft and theresulting exhaust blow pushes the engine and vehicle forward. The exhaust gasses also turn a shaft connected to the inlet turbinewhich continues the compression process. A modern jet engine is made up of several rows of spinningpropeller blades called Rotors. As the airflow goes througheach row, the air is accelerated and compressed. Behind the row isanother set of blades that are not really turningbut attached tothe out housing. These are called Stators. These help tore-direct the flow to be more efficient and prepare it to meet thenext set of spinning blades. After going through several rows ofRotors, the air is compressed. This stage of the engine is calledthe Compressor. The hot gases want to expand and it passes throughanother set of Rotors and Stators that extract some energy out ofthe fast flowing air gases. This section of the engine is the Turbine stage because it acts like the turbines in a dam topull energy out of flowing fluid. This engergy is used to turn theTurbine disc that is connected back to the Compressor stage, thuscompressing the next amount of air entering the engine. The gas escaping the engine has a great amount of energy andvelocity and applies thrust to the engine and thus to theairplane. Theair rotates around the exhaust to reduce friction of exhaust gasesincreasing efficiency and reducing noise. The steps in a jet engine are essentially the same as in a carengine: Intake, Compression, Combustion, Exhaust. In modern jet engines, the air is pulled into the engine by a largedisc of spinning blades called the fan. This is what you see if youlook into the front [intake] of the engine. Behind the fan is thebypass duct [mentioned later] and the engine core. Behind the compressors is the combustion chamber, where the air issprayed with jet fuel from a nozzle and ignited by a flame. It then passes through one more spinning component called theturbine, which accelerates the air out the back of the engine. Thatturbine is connected to the compressors by a shaft running throughthe center of the engine and is what runs them. The bypass duct [mentioned earlier] is simply a hollow areasurrounding the engine core. Some of the air that gets taken in isrouted by the fan through the bypass duct so that it totallybypasses the engine core, and mixes with the exhaust behind theengine. This makes the engine more efficient and muffles the soundof the exhaust, making the engine quieter. A betterunderstanding of thrust A common misconception about thrust is that theexhaust gasses expelled from the rear of the engine cause theengine and the attached aircraft to move forward. This is not true. Although the expelled gasses do add a minimal amount of forwardthrust, the majority of thrust created by the engine is from theaerodynamic forces generated by the aforementioned Rotors. We must first understand that Rotors are aerodynamic devices knownas Airfoils because of their designed curvature. An Airfoil that passes through a body of air will cause apressure differential that causes lift. The wings of anaircraft are examples of an airfoil, and as air passes around thewings, the curvature that engineers design into the wing will causea higher pressure to act upon the underside of the wing, and alower pressure to act upon the upper surface of the wing. As thispressure differential becomes greater, it eventually overcomes thecombined forces of gravity and the mass of the aircraft, and theaircraft flies. This same principle can be used to explain why the Rotors are the primary source of forward thrust. As therotors spin, they too will develop pressure differentials, butbecause they are mounted vertically like a propeller on a smallplane, they will produce forward thrust , instead of creatingupward lift as we are used to associating with horizontallymounted aircraft wings. NASA explanation of thrust See the thediscussion page for more information. How does a jet engine work? A jet engine works by sucking air in the fan at the front of the engine. From the fan section the air enters the compression section which further squeezes the air down. Afterâ€¦ this the air is moved to the combustion section which just as the name suggests ignites a fuel air mixture. The air then travels through two turbine sections, a high and a low pressure turbine section each respectively connected to the compressor and fan sections, thus providing the jet engines self-sustainablility. After all this the air exits the rear of the engine pushing whatever the jet is attached to forward. This is the basic process of a low-bypass jet engine. How jet engine works? The front fan spins at a high rate to pull in air. Once air is pulled in some of it passes through ducts around the engine core and out the back high bypass turbofan engine â€¦and a smaller amount of the air is pulled into the engines core. Once in the core it is compressed in stages gradually gets compressed more and more. Then it enters the combustion chamber where it is mixed with fuel and ignited, then passes into the turbine area where it expands and is propelled out the back. This engine type is perfect for high flying commercial jets because they are fuel efficient. The other type of engine is a low bypass turbofan engine. This is a good engine for supersonic aircraft, but most of the energy generated is from the burning of fuel. Keep in mind that there are many forms of high and low bypass engines each with slightly different fan sized, thrust output, bypass ratios etc.. How does a jet engine works? Air flows into the inlet fan, which pushes the air back farther into smaller fans that push the air into a combustion chamber. In the combustion chamber, the air is ignited wiâ€¦th fuel, creating an explosion which is pushed out the back of the engine as warm air and as thrust to push the airplane along. Also, some cold air actually goes around the main engine, not in it, and out the back as regular air. Why do jet engines work? There is a series of fans, they get deeper into the jet and get smaller, as the fan sucks in air, the air condenses and gets smaller and smaller, at the end of the jet, air isâ€¦ released with an amazing force because the pressure is being released!!! How does the Pulse jet engine work? A pulse jet engine is one of the most simple and efficient propulsion devices ever designed. There are three types of pulse jet engines: The valved pulse jet, the valveless puâ€¦lse jet, and the upright or "Jam jar jet". For complete details on pulse jet engines, go to wikipedia. How does jet fuel help work in a jet engine? Air is sucked into the engine using giant fans called axial compressors compressors for short , which compress the air into a very dense structure. The air is then mixed withâ€¦ jet fuel which creates a very potent flammable mixture which is then lit. After the fuel and air is lit, there is a constant controlled explosion where the air and fuel turns into gas and expands extremely fast and is forced out the back of the jet. Without the fuel, the air would not ignite. Jet fuel is different from gasoline used in passenger cars and has more in common with diesel fuel in which both diesel and jet fuel are designed to have high flash points and allows for high compression. How a jet engine on a jet plane works? A jet engine works basically the same as any engine. Air is brought in the engine and turning blades compress the air and pushes it further back. When it gets to the combustion chamber, fuel is injected and the gas is ignited. As it does, it turns the turbine blades which are connected by a shaft to the front blades and keeps the engine turning. How does the jet engine works? The jet engine takes in air through the large fan on the front. The air then passes through the compression fans, making the air highly compressed. The air is mixed with fuel â€¦before being ignited. The hot gasses push out the back of the engine at high force, creating thrust, making the plane, car, boat, or whatever the jet is on move forward. How does a pulse jet work? Pulse jet is used to power experimental helicopters, it work by attaching the engines to the extreme ends of the rotor blades. As an aircraft propulsion system, pulse-jets havâ€¦e the distinct advantage over conventional turbine engines by not producing the usual reaction torque upon the fuselage. Paul Schmidt in cooperation with the Argus Engine company Share to:

3: HobbyKing Pulse Jet Gasoline Engine "Red Head" with Ignition System

A pulsejet engine (or pulse jet) is a type of jet engine in which combustion occurs in pulses. A pulsejet engine can be made with few [1] or no moving parts, [2] [3] [4] and is capable of running statically (i.e. it does not need to have air forced into its inlet typically by forward motion).

You can see right through the damn thing. Fuel can be gasoline propane, diesel, jet fuel. In fact, anything that will burn in the presence of air. We create a spark and boom, it ignites! That means that the gas inside expands rapidly gets hot and when things get hot they expand. When you have a gas under pressure it tries to flow as quickly as it can to an outlet. At the outlet the pressure equalises with the air outside. In this case that flow is from the combustion chamber through the taper which actually makes it go faster down the tailpipe, and out of the end. Just as our hot-gases are racing down the tailpipe, in that direction the same amount of force is applied to the engine. In that direction the guesses go one way, and the engine tries to go the other way. That attempt to go the other way is the thrust that creates the force on the engine, the motive force. So, here we have it the fuels exploded. All the gases are rushing out the back. But, what happens next? Now, as the hot gas is rushed down the tailpipe driven by the pressure in the combustion chamber and pushing on the front, eventually the pressure in the combustion chamber runs out. Effectively, all the air and fuel has been burnt all, the gases have expanded now suddenly, the pressure in here is the same as the pressure outside. But, the gas is in the tailpipe because the gases are still flowing down here very very quickly. So, this becomes what I like to think of as a a giant syringe, and in effect the gases in the tailpipe here will act like the plunger and a syringe. Not a perfect vacuum, but a reduction in pressure. Now, instead of having more pressure than outside the chamber has less pressure than outside. These gases because they are travelling so fast, and they have a weight or a mass, they continue to travel outwards towards the tailpipe end. This means that the pressure here continues to fall, and eventually it falls so far that some little valves in the front of the engine are pushed open. Pushed by the air pressure outside the difference wing. The pressure outside of the pressure inside, applies a force to those little valves and they open up now, when they open up the outside air. Air can rush into the chamber. Here again just like when we started the cycle repeats itself. It all starts again, and the pulse jet cycles constantly, sucking in the front, blowing out at the back. They are very small, light valves, driven only by the air pressure from the outside of the engine. This with the right dimensions and a valve plate, like this which is not a particularly hard job. Another New Green Invention.

4: How does a pulse jet engine work

The pulse jet engine is an example of the Lenoir cycle. This particular example only works with forward speed to induce the fresh charge each cycle. A charge of air enters through one-way shutters along with a fuel spray. The mixture is ignited by a spark plug. The explosion backpressure closes the.

WonderHowTo Jet engines combine oxygen from the surrounding air with on-board fuel to burn at very high temperatures and create thrust in the direction of the flame. Rockets, which we will learn about in a later post, are similar but carry oxygen internally and can therefore function in space! Contrary to popular belief, jet engines are not hard to make. In just a few minutes, you will be on your way to starting your own personal NASA program! It all begins with the glass jar jet engine! Materials Methanol antifreeze is almost pure methanol Glass jar with a metal screw cap Hammer and nail or a drill Safety goggles Long match or a ruler to tie a small match onto Long matches will keep you a safe distance from the flame. The wood will stop the drill from scratching the table, too. Step 2 Drill a Hole Drill a small hole at the center of the cap. Later on, you can experiment with different hole sizes to see how they affect the performance of your jar jet engine. Step 3 Freeze the Jar Place your jar in the freezer for a few minutes. This will decrease the likelihood of your glass jar cracking due to overheating. Wait until the glass frosts, then remove the jar from the freezer. Step 4 Prepare the Jar Place the frosty glass jar in a safe, non-flammable environment. I set mine on the shell of an old VCR that I sacrificed to the scavenging gods. The metal shell will keep heat and broken glass off of the table. Step 5 Pour In the Methanol Pour a tiny bit of methanol into the jar, as shown in the following photo. Just a spoonful or two will be enough. Step 6 Fasten the Cap Make sure it is on really tight. Step 7 Ignite the Jet Engine Attach the match to the end of your ruler or stick. Light the match away from the jar. With the match extended away from your body, bring the flame to the opening in the cap. Before lighting your jet, put on safety goggles and make sure all sentient beings are well clear of the jar. Always have a fire extinguisher on hand when experimenting with fire. Be sure to let the glass cool down for a few minutes before touching it again. This vapor flows toward the opening at the top of the jar. When the match flame meets the vapor, it ignites the entire vapor cloud. The combustion consumes the oxygen in the jar, while more oxygen is sucked in through the lid. This results in the upside-down tornado shape of the jet flame. Afterthoughts After the first run, the inside of the cap was burned in a circular pattern! If you look closely, you will see that the burn is slightly lopsided. The hole is likely off center, so the escaping fire oscillates around the opening. The constant heat caused this jar to break after three uses. Now, try making your own miniature jam jet engine at home and share your experience with the community! Make sure to post any pictures and videos that you take of your valveless jet engine onto the community corkboard , and if you have any questions, ask them below in the comments or in the forum. I am always here to help make your science dreams a reality.

5: How Does a Pulsejet Engine Work? - www.enganchecubano.com

How to Build a Pulse Jet Start with a well-proven design, like Cottrill's focused wave pulse jet engine. This is a valveless pulse jet designed so that the combustion chamber consists of.

Yet, this is completely true. In its most basic form â€" the valveless pulsejet -- the jet engine can be just an empty metal tube shaped in a proper way. Everyone able to cut sheet metal and join metal parts can build one in a garage or basement workshop. Due to peculiar historical circumstances, this interesting fact has escaped popular attention. It is not familiar even to enthusiasts of jet propulsion. Few if any people can be seen flying aircraft powered by jet engines they have built themselves. This document aims to help change that. However, it is not a how-to primer. It is an attempt to describe and explain the valveless pulsejet in principle. It also offers a rough sketch of the amazing variety of layouts the inventors and developers have tried during the long but obscure history of this device. My aim is to inspire, rather than teach. My goal is to demonstrate that jet power is accessible to everyone in a great variety of simple ways. Should you find the inspiration, plenty of information on the practical steps towards jet power will be available elsewhere. The picture below shows one of the many possible layouts of a valveless pulsejet engine. It has a chamber with two tubular ports of unequal length and diameter. The port on the right, curved backwards, is the intake pipe. The bigger, flared one on the left is the exhaust, or tailpipe. In some other engines, it is the exhaust pipe that is bent into the U-shape, but the important thing is that the ends of both ports point in the same direction. When the fuel-air mixture combusts in the chamber, the process generates a great amount of hot gas very quickly. This happens so fast that it resembles an explosion. The immediate, explosive rise in internal pressure first compresses the gas inside and then pushes it forcefully out of the chamber. Two powerful spurts of hot expanding gas are created â€" a big one that blows through the tailpipe and a smaller one blowing through the intake. Leaving the engine, the two jets exert a pulse of thrust â€" they push the engine in the opposite direction. As the gas expands and the combustion chamber empties, the pressure inside the engine drops. Due to inertia of the moving gas, this drop continues for some time even after the pressure falls back to atmospheric. The expansion stops only when the momentum of the gas pulse is completely spent. At that point, there is a partial vacuum inside the engine. The process now reverses itself. The outside atmospheric pressure is now higher than the pressure inside the engine and fresh air starts rushing into the ends of the two ports. At the intake side, it quickly passes through the short tube, enters the chamber and mixes with fuel. The tailpipe, however, is rather longer, so that the incoming air does not even get as far as the chamber before the engine is refilled and the pressure peaks. One of the prime reasons for the extra length of the tailpipe is to retain enough of the hot exhaust gas within the engine at the moment the suction starts. This gas is greatly rarified by the expansion, but the outside pressure will push it back and increase its density again. The heat of the chamber and the free radicals in the retained gas will cause ignition and the process will repeat itself. The spark plug shown on the picture is needed only at start-up. Once the engine fires, the retained hot gas provides self-ignition and the spark plug becomes unnecessary. Indeed, if spark ignition is left on, it can interfere with the normal functioning of the engine. It took me more than words to describe it, but this cycle is actually very brief. In a small flying model-sized pulsejet, it happens more than times a second. The cycle is similar to that of a conventional flap-valve pulsejet engine, like the big Argus which powered the V-1 flying bomb or the small Dynajet used to power flying models. There, the rising pressure makes the valve flaps snap shut, leaving only one way for the hot gas to go -- into the exhaust tube. In the J-shaped and U-shaped valveless engines, gas spews out of two ports. It does not matter, because they both face in the same direction. Some valveless pulsejet designers have developed engines that are not bent backwards, but employ various tricks that work in a similar fashion to valves -- i. We shall describe some of those tricks at a later point. You may wonder about the sharp transition from the intake tract into the chamber. It is necessary to generate strong turbulence in the incoming air, so that it mixes with injected fuel properly. A gentler, more gradual entry would not generate the necessary swirling of gases. In addition, turbulence increases the intensity of combustion and the rate of the heat release. The first pulsejet engines were built in France at the very beginning of the 20th century. They found only very limited use at the time and were soon forgotten for all practical purposes. In the s, however, German engineer Paul Schmidt rediscovered the principle by accident while trying to develop a detonation engine. He built a series of impressive pulsejets with valves. At roughly the same time and in the same country, engineers at the Argus engine company were working on a valveless device that used compressed air. The circumstances were much more propitious now. The world was preparing for a big war and the war machines were gearing up. The German War Ministry brought Schmidt and Argus together, which resulted in the development of the first mass produced jet engine. Like the Schmidt engines, it used valves and natural aspiration, but its mechanisms were greatly modified by Argus. Thus, while the opposed sides in World War II were still trying to put together their first jet-powered fighter aircraft in , the Vergeltungswaffe 1 or V-1 for short was regularly buzzing its way to England with a 1,lb load of explosives. Its Fieseler airframe was powered by the Argus As pulsejet engine. You can see one flying over the English countryside on the photo on the right. The utter simplicity, low cost and demonstrated effectiveness of the pulsejet impressed the Allies so much that they badly wanted to have something similar. It looked amazing to everyone that a device that simple could power a serious flying machine. Captured examples of the Argus were carefully studied and copies built and tested. It soon became obvious that the pulsejet had certain drawbacks and limitations, but the basic principle still looked very attractive and ideas for improvement abounded. Various uses for the device were contemplated. Ford Motor Company built a proper assembly line to manufacture Argus copies. With the end of the war, some of the projects were scuttled, but the Cold War started soon and the quest for a better pulsejet continued. Unfortunately, progress was very slow and purely incremental. In the mid s, after a decade of effort, developers were not that much better off than their wartime German predecessors. In total contrast, the advances in turbojet design over the same period were tremendous. By that time, turbojet-powered fighters already had the Korean War behind them. Turbojet strategic bombers were carrying nuclear weapons in their bomb bays and turbojet airliners were getting ready to earn their money carrying businessmen and the idle rich from continent to continent. It was becoming completely clear to everyone that the turbojet was the jet engine of the future. Engineers were still excited by the promise of the pulsejet, but the reality was not to be denied. During the s and s, most pulsejet researchers gradually abandoned their efforts and turned to other things. What originally attracted and excited the researchers and developers most of all about the pulsejet engine was a peculiar property of pulsating combustion â€" it can be self-compressing. In the pulsejet, the fuel-air mixture does not burn steadily, at a constant pressure, as it does in the other jet engines. It burns intermittently, in a quick succession of explosive pulses. In each pulse, the gaseous products of combustion are generated too fast to escape from the combustor at once. This raises the pressure inside the combustor steeply, which increases combustion efficiency. The pulsejet is the only jet engine combustor that shows a net pressure gain between the intake and the exhaust. All the others have to have their highest pressure created at the intake end of the chamber. From that station on, the pressure falls off. Such a decreasing pressure gradient serves to prevent the hot gas generated in the combustor from forcing its way out through the intake. This way, the gas moves only towards the exhaust nozzle in which pressure is converted to speed. The great intake pressure is usually provided by some kind of compressor, which is a complex and expensive bit of machinery and consumes a great amount of power. Much of the energy generated in the turbojet engine goes to drive a compressor and only the remainder provides thrust. The pulsejet is different. Here, the exhaust pressure is higher than the intake pressure. There is pressure gain across the combustor, rather than loss. Moreover, the pulsejet does it without wasting the power generated by combustion. This is very important. According to some rough figures, a 5- percent gain in combustion pressure achieved by this method gives about the same improvement in overall efficiency as the percent gain produced by a compressor, all other things being equal. Personally, I am interested in the pulsejet for another reason -- because it brings the jet engine back to the people. It is a back-to-basics kind of machine, so simple to be accessible even to enthusiasts with rudimentary skills and simple tools. Turbojets and fanjets are at the opposite end of the complexity scale. In most cases they employ inaccessible, cutting-edge technology. Just look at the collection of pulsejets on the picture on the right.

6: V 1 flying bomb

Today, I'm going to talk a little bit about how pulsejet engines work. I'm gonna do my best to explain how pulsejet engines work to you. This is a typical pulsejet engine, is pretty much a long pipe.

There are two main types of pulsejet engines, both of which use resonant combustion and harness the expanding combustion products to form a pulsating exhaust jet which produces thrust intermittently. Valved pulsejets Edit Valved pulsejet engines use a mechanical valve to control the flow of expanding exhaust, forcing the hot gas to go out the back of the engine through the tailpipe only, and allow fresh air and more fuel to enter through the intake. The valved pulsejet comprises an intake with a one-way valve arrangement. The superheated exhaust gases exit through an acoustically resonant exhaust pipe. The valve arrangement is commonly a daisy valve or a reed valve. The daisy valve is less effective than a rectangular valve grid, although it is easier to construct on a small scale. Valveless pulsejets Edit Valveless pulsejet engines have no moving parts and use only their geometry to control the flow of exhaust out of the engine. Valveless pulsejets expel exhaust out of both the intakes and the exhaust, though most try to have the majority of exhaust go out the longer tail pipe for more efficient propulsion. Fuel, as a gas or liquid vapour, is either mixed with the air in the intake or directly injected into the combustion chamber. Starting the engine usually requires forced air and an ignition source, such as a spark plug, for the fuel-air mix. With modern manufactured engine designs, almost any design can be made to be self-starting by providing the engine with fuel and an ignition spark, starting the engine with no compressed air. Once running, the engine only requires input of fuel to maintain a self-sustaining combustion cycle. History Edit First patented pulse jet engine prototype of the modern jet engine was invented by Russian inventor and artillery officer N. Also, the Swedish inventor Martin Wiberg has a claim to having invented the first pulse jet in Sweden, but exact details of the patent are unclear. The first working pulsejet was patented in by Russian engineer V. Karavodin, who completed a working model in The French inventor Georges Marconnet patented his valveless pulsejet engine in , which many commentators argue[attribution needed] greatly influenced the V-1 flying bomb through engineer Paul Schmidt, who pioneered a more efficient design based on modification of the intake valves or flaps , earning him government support from the German Air Ministry in For more information see http: Madelung co-invented the ribbon parachute , a device used to stabilise the V-1 in its terminal dive. The original Schmidt design had the pulsejet placed in a fuselage like a modern jet fighter, unlike the eventual V-1 which had the engine placed above the warhead and fuselage. Fritz Gosslau of Argus and the Siemens company, which were all combined to work on the V The pulsejet was evaluated to be an excellent balance of cost and function: The simple resonant design based on the ratio 8. Contrary to popular belief,[citation needed] the engine casing did not provide sufficient heat to cause Diesel -type ignition of the fuel, as there is insignificant compression within a pulsejet engine. The Argus As valve array was based on a shutter system that operated at the 43 to 45 cycles-per-second frequency of the engine. Three air nozzles in the front of the Argus As were connected to an external high pressure source to start the engine. The fuel used for ignition was acetylene , with the technicians having to place a baffle of wood or cardboard in the exhaust pipe to stop the acetylene diffusing before complete ignition. Once the engine ignited and minimum operating temperature was attained, external hoses and connectors were removed. The V1, being a cruise missile, did not have any landing gear, thus the Argus As was launched on an inclined ramp powered by a piston -driven steam catapult. Steam power to fire the piston was generated by the violent exothermic chemical reaction created when hydrogen peroxide and potassium permanganate termed T-Stoff and Z-Stoff are combined. Wright Field technical personnel reverse-engineered the V-1 from the remains of a V-1 that had failed to detonate in Britain. Designers of modern cruise missiles do not choose pulsejet engines for propulsion, preferring turbojets or rocket engines. Operation Edit Animation of a pulse jet engine. Pulsejet engines are characterized by simplicity, low cost of construction, and high noise levels. Pulsejet fuel efficiency is a topic for hot debate, as efficiency is a relative term. While the thrust-to-weight ratio is excellent, thrust specific fuel consumption is generally very poor. This limits the maximum pre-combustion pressure ratio, to perhaps 1. The high noise levels usually make them impractical for other than military and other similarly restricted applications. Pulsejets have been used to power experimental helicopters, the engines being attached to the ends of the rotor blades. A helicopter may be built without a tail rotor and its associated transmission and drive shaft, simplifying the aircraft though it is still necessary to rotate the fuselage relative to the rotors in order to keep it pointing in one direction. This concept had been considered as early as One company, Beck Technologies, has produced a valved pulsejet design with variable intake geometry, allowing the intake to open and close to control ram airflow, and letting the engine produce full power at any speed. Valveless designs are not as negatively affected by ram air pressure as other designs, as they were never intended to stop the flow out of the intake, and can significantly increase in power at speed. Another feature of pulsejet engines is that their thrust can be increased by a specially shaped duct placed behind the engine. The duct acts as an annular wing , which evens out the pulsating thrust, by harnessing aerodynamic forces in the pulsejet exhaust. The duct, typically called an augmenter, can significantly increase the thrust of a pulsejet with no additional fuel consumption. However, the larger the augmenter duct, the more drag it will produce, and it may only be effective at certain speed ranges. Most vehicles will be drag-limited at a much lower speed than the speed at which a small to moderate-size augmenter will stop producing positive thrust increase. Function Edit Pulse jet schematic. First part of the cycle: The combustion cycle comprises five or six phases: Starting with ignition within the combustion chamber, a high pressure is raised by the combustion of the fuel-air mixture. The pressurized gas from combustion cannot exit forward through the one-way intake valve and so exits only to the rear through the exhaust tube. The inertial reaction of this gas flow causes the engine to provide thrust, this force being used to propel an airframe or a rotor blade. The inertia of the traveling exhaust gas causes a low pressure in the combustion chamber. This pressure is less than the inlet pressure upstream of the one-way valve , and so the induction phase of the cycle begins. In the simplest of pulsejet engines this intake is through a venturi which causes fuel to be drawn from a fuel supply. In more complex engines the fuel may be injected directly into the combustion chamber. When the induction phase is under way, fuel in atomized form is injected into the combustion chamber to fill the vacuum formed by the departing of the previous fireball; the atomized fuel tries to fill up the entire tube including the tailpipe. This causes atomized fuel at the rear of the combustion chamber to "flash" as it comes in contact with the hot gases of the preceding column of gasâ€”this resulting flash "slams" the reed-valves shut or in the case of valveless designs, stops the flow of fuel until a vacuum is formed and the cycle repeats. Valved design Edit There are two basic types of pulsejets. The first is known as a valved or traditional pulsejet and it has a set of one-way valves through which the incoming air passes. The cycle frequency is primarily dependent on the length of the engine. For a small model-type engine the frequency may be around pulses per second, whereas for a larger engine such as the one used on the German V-1 flying bomb , the frequency was closer to 45 pulses per second. The low-frequency sound produced resulted in the missiles being nicknamed "buzz bombs. Valveless pulse jet The second type of pulsejet is known as the valveless pulsejet. Valveless pulsejets come in a number of shapes and sizes, with different designs being suited for different functions. A typical valveless engine will have one or more intake tubes, a combustion chamber section, and one or more exhaust tube sections. The intake tube takes in air and mixes it with fuel to combust, and also controls the expulsion of exhaust gas, like a valve, limiting the flow but not stopping it altogether. While the fuel-air mixture burns, most of the expanding gas is forced out of the exhaust pipe of the engine. Because the intake tube s also expel gas during the exhaust cycle of the engine, most valveless engines have the intakes facing backwards so that the thrust created adds to the overall thrust, rather than reducing it. The combustion creates two pressure wave fronts, one traveling down the longer exhaust tube and one down the short intake tube. While some valveless engines are known for being extremely fuel-hungry, other designs use significantly less fuel than a valved pulsejet, and a properly designed system with advanced components and techniques can rival or exceed the fuel efficiency of small turbojet engines. In , Georges Marconnet developed the first pulsating combustor without valves. It was the grandfather of all valveless pulsejets. They can achieve higher top speeds, with some advanced designs being capable of operating at Mach. The advantage of the acoustic-type pulsejet is simplicity. Since there are no moving parts to wear out, they are easier to maintain and simpler to construct. Future uses Edit Pulsejets are used today in target drone aircraft, flying control line model aircraft as well as radio-controlled aircraft , fog generators, and industrial drying and home heating equipment. Because pulsejets are an efficient and simple way to convert fuel into heat, experimenters are using them for new industrial applications such as biomass fuel conversion, boiler and heater systems, and other applications. Some experimenters continue to work on improved designs. The engines are difficult to integrate into commercial manned aircraft designs because of noise and vibration, though they excel on the smaller-scale unmanned vehicles. The pulse detonation engine PDE marks a new approach towards non-continuous jet engines and promises higher fuel efficiency compared to turbofan jet engines, at least at very high speeds. Most PDE research programs use pulsejet engines for testing ideas early in the design phase.

7: Pratt & Whitney | Pulse

As opposed to pulse jet engines, which operate based on deflagration, which means subsonic combustion, pulse detonation engines, as the name implies, operate on the supersonic detonation of fuel. The detonation of the fuel happens rapidly enough that the gasses do not have time to expand before the entire cycle is detonated, allowing for much.

Sat Oct 04, 7: It has a chamber with two tubular ports of unequal length and diameter. The port on the right, curved backwards, is the intake pipe. The bigger one on the left is the exhaust, or the tailpipe. Fuel is most often gaseous or liquid propane, but some engines, especially those with valves, run on gasoline, methanol and other liquid fuels, even the Jet-A. In some other valveless engines, it is the exhaust pipe that is bent into the U-shape, but the important thing is that the ends of both ports point in the same direction. In this website, you may see a number of engines that are not bent, but this is often done for simplicity. For experimental purposes, builders often ignore the fact that thrust in exerted in two directions at once. They build a bent engine only when they actually want to power something with it. Back to the picture. Imagine fuel squirted into the chamber and mixed with air. Imagine the spark plug producing a spark. When the fuel-air mixture combusts in the chamber, the process generates a great amount of hot gas. The rising pressure forces the hot gas to expand out of the chamber and pass through the two ports at high speed. As they leave the engine, the two jets of hot gas exert thrust. They push the engine in the opposite direction. This is jet propulsion. As the hot gas blows out of the engine, the pressure inside the chamber drops. Due to inertia, this drop continues even after the pressure falls back to atmospheric. At the lowest point of the process, there is partial vacuum in the chamber. The outside atmospheric pressure is now higher than the pressure inside the engine. The process now reverses itself. Fresh air starts rushing into the ends of the two ports. At the intake side, it quickly passes through the short tube, enters the chamber and mixes with fuel. The tailpipe, however, is rather longer, so that the incoming air does not even get as far as the chamber before the pressure peaks and the engine is refilled. One of the prime reasons for the extra length of the tailpipe is to retain some of the hot exhaust gas within the engine at the moment the suction starts. The heat and the dissociated free radicals in the gas will eventually cause ignition and the process will repeat itself. Ignition is thus automatic. You only have to ignite the mixture once, at the start, either with a spark plug or anything else you may think of. Once it fires the first time, the engine provides its own ignition. The above cycle is very brief. In a small flying model-sized pulsejet, it happens to times a second! The individual cycles cannot be distinguished by ear. Instead, there is a very loud! The cycle is not much different in the conventional flap-valve pulsejet, like the big Argus or the small Dynajet see the next picture. There, the rising pressure inside the chamber makes the valve flaps at the front of the chamber snap shut and there is only one way for the hot gas to go -- into the exhaust tube. Some valveless engine designers have developed designs that are not bent backwards, but employ various tricks that work in a similar fashion to valves -- i. Some of those tricks are described elsewhere on this website. You do not have the required permissions to view the files attached to this post.

8: jet engine - What are the pros and cons of a pulsejet? - Aviation Stack Exchange

A valveless pulsejet (or pulse jet) is the simplest known jet propulsion device. Valveless pulsejets are low in cost, light weight, powerful and easy to operate. Valveless pulsejets are low in cost, light weight, powerful and easy to operate.

Consequently, it needs speed to work well. If the pulse jet is on the ground, it is not easy to start - it needs to be fed with compressed air, and once it runs it can run even when not moving because the oscillating pressure wave inside the tube will compress the inflowing air , it develops litte thrust. Thrust will go up with airspeed, so you need additional thrust sources for initial acceleration and take-off. In case of the V-1, this was done by a steam catapult or by air-launching the device. Most of the development work went into making the airframe withstand this acceleration. A modern design would need additional engines as well, and once those are included, the rationale for pulse jets becomes very weak. They make sense if you have an air-launched, disposable application, such as long-range air-to-air missiles. This is a niche in which their higher-speed cousins, the ramjets, will still be used. Very easy to build, very light. Runs and produces some thrust when at rest as opposed to ramjets. Thrust grows with flight speed. This can be seen as a pro, but normally requires additional means of acceleration. Therefore listed as contra here. The fuel energy is converted to other forms of energy: Just listen to the videos of Colin Furze to get an idea. High levels of vibration due to the intermittent operation. When the Heinkel was tried out with Argus pulsejets , the aircraft experienced unacceptable vibration. The central part will get very hot in operation, so at least nickel-chrome stainless steel is needed if air cooling is insufficient. For this, there are ramjets. NACA tested the As pulse jet and wrote a report , from which the performance data depicted below is taken: It seems that Bruce Simpson over in New Zealand has improved the pulse jet design a lot: He needs no compressed air for starting and makes clever use of surrounding cold air to increase mass flow and keep material temperatures down.

9: Pulse Jet Engines

Making A Pulse Jet Engine It powers a scale model MiG 15 fighter at 85mph. This is a powerful jet unit and one which can be made by anyone with access to lathe and welding facilities. Emil Brauner of Kladno in Czechoslovkia is a model maker who was forced by circumstance to make his own jet.

Basic characteristics[edit] A pulsejet engine is an air-breathing reaction engine that employs an ongoing sequence of discrete combustion events rather than one sustained combustion event. This clearly distinguishes it from other reaction engine types such as rockets , turbojets , and ramjets , which are all constant combustion devices. All other reaction engines are driven by maintaining high internal pressure; pulsejets are driven by an alternation between high and low pressure. This alternation is not maintained by any mechanical contrivance, but rather by the natural acoustic resonance of the rigid tubular engine structure. The valveless pulsejet is, mechanically speaking, the simplest form of pulsejet, and is, in fact, the simplest known air-breathing propulsion device that can operate "statically", i. The combustion events driving a pulsejet are often informally called explosions ; however, the correct term is deflagrations. The deflagration within the combustion zone of a pulsejet is characterized by a sudden rise in temperature and pressure followed by a rapid subsonic expansion in gas volume. It is this expansion that performs the main work of moving air rearward through the device as well as setting up conditions in the main tube for the cycle to continue. A pulsejet engine works by alternately accelerating a contained mass of air rearward and then breathing in a fresh mass of air to replace it. The energy to accelerate the air mass is provided by the deflagration of fuel mixed thoroughly into the newly acquired fresh air mass. This cycle is repeated many times per second. These pulses of force, rapidly repeated over time, comprise the measurable thrust force of the engine. Some basic differences between valved and valveless pulsejets are: Valveless pulsejet engines have no mechanical valve, eliminating the only internal "moving part" of the conventional pulsejet. Valveless engines produce thrust forces in two distinct but synchronized mass acceleration events per cycle, rather than just one. Basic valved pulsejet theory[edit] In a conventional "valved" pulsejet, like the engine of the infamous V-1 "buzz bomb" of World War II, there are two ducts connected to the combustion zone where the explosions occur. These are generally known as the "intake" a very short duct and the "tailpipe" a very long duct. The purpose of the rear-facing tailpipe is to provide air mass for acceleration by the explosive blast as well as to direct the accelerated mass totally rearward. The combustion zone usually a widened "chamber" section and tailpipe make up the main tube of the engine. A flexible, low mass one-way valve or multiple identical valves separates the intake from the combustion zone. At the beginning of each cycle, air must be pulled into the combustion zone. At the end of each cycle, the tailpipe must be reloaded with air from the surrounding atmosphere. Both of these basic actions are accomplished by a significant drop in pressure that occurs naturally after the deflagration expansion, a phenomenon known as the Kadenacy effect named after the scientist who first fully described it. It also causes a reversal of flow in the tailpipe that draws fresh air forward to re-fill the pipe. When the next deflagration occurs, the rapid pressure rise slams the valve shut very quickly, ensuring that almost no explosion mass exits in the forward direction so the expansion of the combustion gases will all be used to accelerate the replenished mass of air in the long tailpipe rearward. Valveless pulsejet operation[edit] The valveless pulsejet is not really valveless â€” it just uses the mass of air in the intake tube as its valve, in place of a mechanical valve. It cannot do this without moving the intake air outward, and this volume of air itself has significant mass, just as the air in the tailpipe does â€” therefore, it is not blown away instantly by the deflagration but is accelerated over a significant fraction of the cycle time. In all known successful valveless pulsejet designs, the intake air mass is a small fraction of the tailpipe air mass due to the smaller dimensions of the intake duct. This means that the intake air mass will be cleared out of contact with the body of the engine faster than the tailpipe mass will. The carefully designed imbalance of these two air masses is important for the proper timing of all parts of the cycle. When the deflagration begins, a zone of significantly elevated pressure travels outward through both air masses as a compression wave. This wave moves at the speed of sound through both the intake and tailpipe air masses. Because these air masses are significantly elevated in temperature as a result of earlier cycles, the speed of sound in them is much higher than it would be in normal outdoor air. When a compression wave reaches the open end of either tube, a low pressure rarefaction wave starts back in the opposite direction, as if "reflected" by the open end. This low pressure region returning to the combustion zone is, in fact, the internal mechanism of the Kadenacy effect. There will be no "breathing" of fresh air into the combustion zone until the arrival of the rarefaction wave. The wave motion through the air masses should not be confused with the separate motions of the masses themselves. At the start of deflagration, the pressure wave immediately moves through both air masses, while the gas expansion due to combustion heat is just beginning in the combustion zone. The intake air mass will be rapidly accelerated outward behind the pressure wave, because its mass is relatively small. The tailpipe air mass will follow the outgoing pressure wave much more slowly. Also, the eventual flow reversal will take place much sooner in the intake, due to its smaller air mass. The timing of the wave motions is determined basically by the lengths of the intake and main tube of the engine; the timing of mass motions is determined mostly by the volumes and exact shapes of these sections. Both are affected by local gas temperatures. In the valveless engine, there will actually be two arrivals of rarefaction waves â€” first, from the intake and then from the tailpipe. In typical valveless designs, the wave that comes back from the intake will be relatively weak. Its main effect is to begin flow reversal in the intake itself, in effect "pre-loading" the intake duct with fresh outdoor air. The actual breathing of the engine as a whole will not begin in earnest until the major low pressure wave from the tailpipe reaches the combustion zone. Once that happens, significant flow reversal begins, driven by the drop in combustion zone pressure. During this phase, too, there is a difference in action between the very different masses in the intake and tailpipe. The intake air mass is again fairly low, but it now almost totally consists of outside air; therefore, fresh air is available almost immediately to begin re-filling the combustion zone from the front. The tailpipe air mass is also pulled, eventually reversing direction as well. The tailpipe will never be completely purged of hot combustion gases, but at reversal it will be easily able to pull in fresh air from all sides around the tailpipe opening, so its contained mass will be gradually increasing until the next deflagration event. Practical design issues[edit] In practical designs there is no need for a continuous ignition system â€” the combustion zone is never totally purged of combustion gases and free radicals , so there is enough chemical action in the residue in the combustion zone to act as an igniter for the next blast once the mixture is up to a reasonable density and pressure: While it is theoretically possible to have such an engine without a distinct "combustion chamber" larger than the tailpipe diameter, all successful valveless engines designed so far have a widened chamber of some sort, roughly similar to that found in typical valved engine designs. The chamber typically takes up a fairly small fraction of the overall main tube length. Various engine geometries have been used to make the thrust forces from the two ducts act in the same direction. One simple method is to turn the engine around and then put a U-bend in the tailpipe, so both ducts are spouting rearward, as in the Ecrevisse and Lockwood also known as Lockwood-Hiller types. The Escopette and Kentfield designs use recuperators U-shaped auxiliary tubes mounted in front of the front-firing intakes to turn the intake blast and flow rearward. The so-called "Chinese" and Thermojet styles simply mount the intake on the chamber in a rear-spouting direction, leaving the front face of the chamber unbroken. The basic internal operation of the engine with these geometries is no different from that described above, however. The Lockwood is unique in one respect, namely, its very large diameter intake â€” the thrust from this large tube is no less than 40 percent of the engine thrust as a whole. The tailpipe volume of this design is quite large, though, so the imbalance of the contained masses is still clearly seen. The pressure drop in this case is caused more by cooling of the gas in chamber than by gas inertia. Gas inertia can not be used well in this design because of lack of exhaust resonator pipe and very dissipative aerodynamics of the aperture. Most pulsejet engines use independent intake and exhaust pipes. A physically simpler design combines the intake and exhaust aperture. This is possible due to the oscillating behaviour of a pulse engine. One aperture can act as exhaust pipe during the high-pressure phase of the work cycle and as intake during the aspiration phase. This engine design is less efficient in this primitive form due to its lack of a resonant pipe and thus a lack of reflected compressing and sucking acoustic waves. However it works fairly well with a simple instrument such as jam jar with a pierced lid and fuel inside, hence the name. Successful versions of the jam jar jet have been run in a plastic bottle. The bottle is far less efficient than the jam jar versions and is unable to sustain a decent jet for more than a few seconds. It is theorized that the alcohol that was used to operate the simple jet was acting as a barrier to stop the heat getting all the way through to the plastic. For the jam jar jet design to work the propellant must be vaporised to ignite which is most often done by a shaking of the jet which causes the propellant to coat the container, therefore giving the theory some validity. The smallest ones are only successful when extremely fast-burning fuels are employed acetylene or hydrogen , for example. Medium and larger sized engines can be made to burn almost any flammable material that can be delivered uniformly to the combustion zone, though of course volatile flammable liquids gasoline , kerosene , various alcohols and standard fuel gases LPG , propane , butane , MAPP gas are easiest to use. Because of the deflagration nature of pulsejet combustion, these engines are extremely efficient combustors, producing practically no hazardous pollutants[citation needed], even when using hydrocarbon fuels. With modern high-temperature metals for the main structure, engine weight can be kept extremely low. Without the presence of a mechanical valve, the engines require practically no ongoing maintenance to remain operational. Up to the present, the physical size of successful valveless designs has always been somewhat larger than valved engines for the same thrust value, though this is theoretically not a requirement. Like valved pulsejets, heat engines frequently run white hot and very high operational noise levels decibels is possible [2] are among the greatest disadvantages of these engines. An ignition system of some sort is required for engine startup. In the smallest sizes, forced air at the intake is also typically needed for startup. There is still much room for improvement in the development of really efficient, fully practical designs for propulsion uses. One possible solution to the ongoing problem of pulsejet inefficiency would be to have two pulsejets in one, with each blast compressing the mixture of fuel and air in the other, and both ends discharging into a common chamber through which air flows only one way. This could potentially allow much higher compression ratios, better fuel efficiencies, and greater thrust.

PULSE JET ENGINE WORKING pdf

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