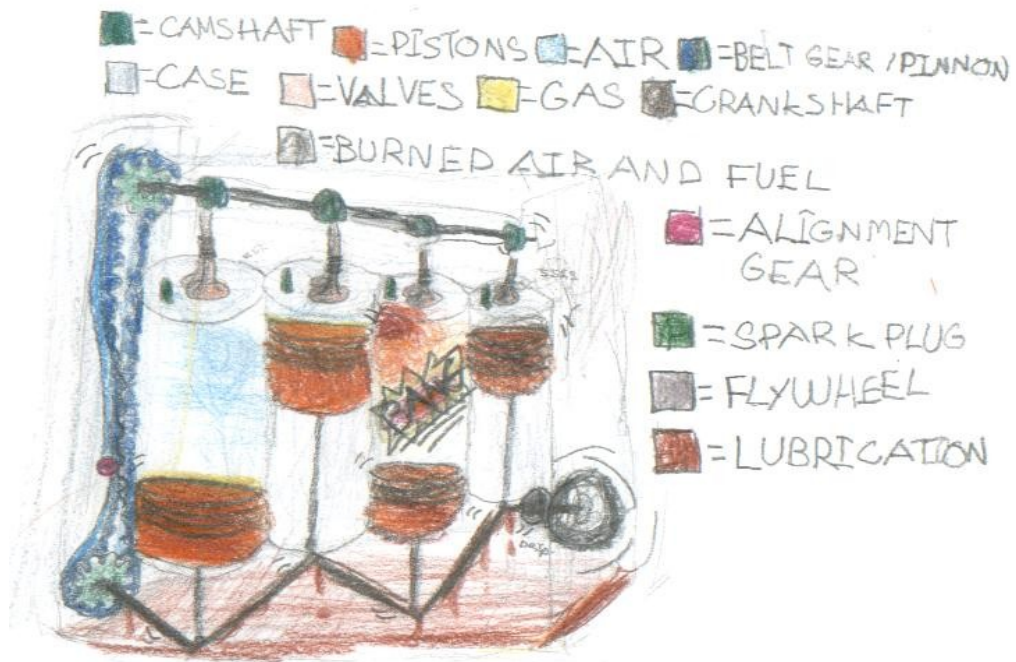


The Internal-Combustion Engine



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The Internal-Combustion Engine

by Christian Chapman

Introduction

This report is mainly about the mechanics and history of the internal-combustion engine. Internal-combustion engines are found almost everywhere in daily use. Cars, trucks, motor scooters, tractors, motorcycles, and even some pumps have internal-combustion engines. Its invention has benefited modern life.

Mechanic System

A gasoline engine has several important parts, yet all, even the simplest, are completely necessary to keep the engine going. They include the crankshaft, camshaft, pistons, cylinders, valves, flywheel, and muffler.

First, there are some tubes inside the engine called cylinders that are very

lubricated with oil on the inside. The cylinders hold up the pistons which are like corks in the bottoms of cans. If you punch a hole in the bottom of the can and blow in it, the cork will go up from the bottom to the top. The pistons do the same thing inside the cylinders.

A crankshaft is a crooked shaft that goes through the engine. It converts the pistons' simple up-down movement to rotary movement that is useful for cars and other things that need rotary movement. It also holds up the pistons so that they do not fall.

A camshaft is a shaft that turns like the crankshaft. However, the camshaft has stubs sticking out of it that push on valves to let gas and air in and out for the pistons to compress before the spark plug ignites the mixture. The camshaft also controls the valves to let out the exhaust.

Another series of parts are the valves. The valves are like double headed nails with springs on them. The camshaft pushes the valves down using its stubs, letting air and gas in or exhaust out.

The Ignition System

The ignition system is not a single part. Rather, it is a combination of many small parts. A battery sends a low voltage charge through a wire that is coiled at the end. Then at the gap, it creates a magnetic field that creates a spark the instant the charge is used up.

The field causes a current with a huge voltage to be generated in the other side of the coil sufficient to power the spark plugs.



Figure 1

How an Engine Works

The piston cycle for a four-stroke engine begins with the valves closed and the

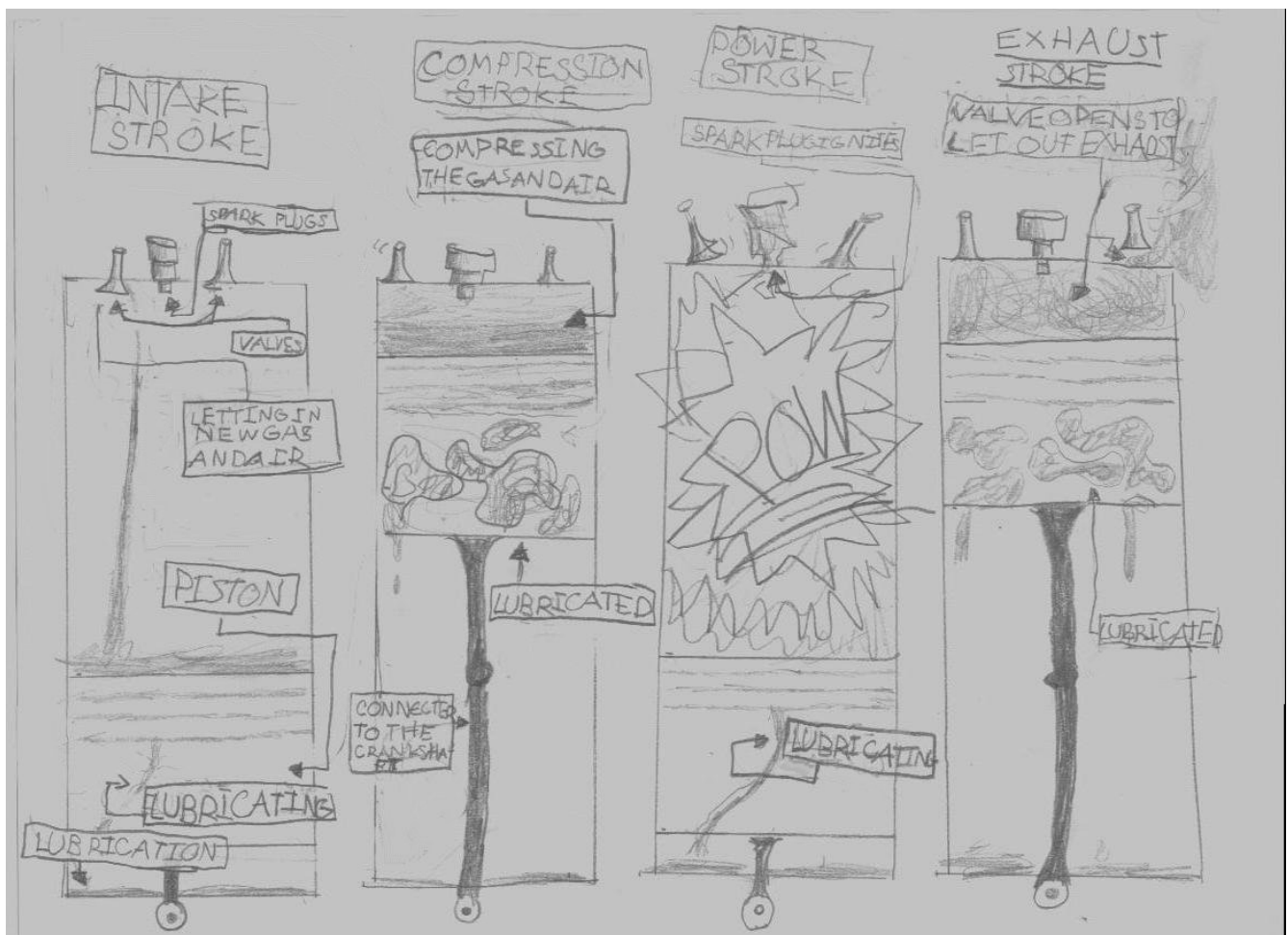


Figure 2

piston up. The piston goes down, causing the intake valve to open and sucking in gasoline and air through it. This is called the intake stroke. The air and gasoline then get compressed as the piston moves upward and closes the opened valve. This is called the compression stroke. Then, the spark plug ignites, and the air and gas blow up. When this happens, the piston is pushed back down. This is called the power stroke. As the piston goes up again, the exhaust valve is opened and the left-over gases from the power stroke are pushed out. This is called the exhaust stroke. Then, the cycle starts all over again. (See Figure 2)

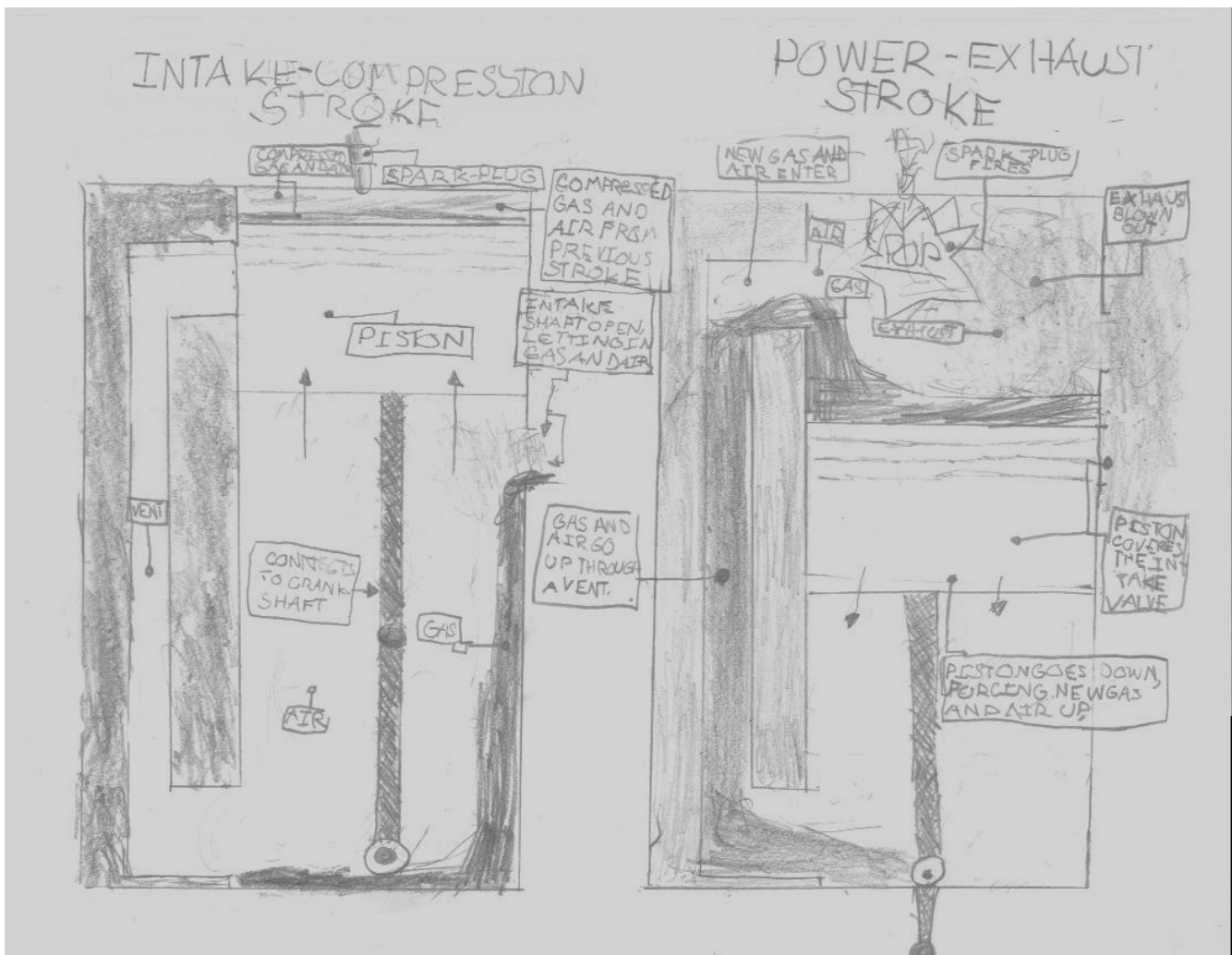


Figure 3

On a two stroke engine, the cycle starts with the piston at the bottom of its stroke going up just like the four stroke engine. However, the cylinder already contains compressed air and gas from the previous stroke. While it is going up, it sucks in gas and air for next time. When the piston is at the top of its stroke, the spark plug fires and forces the piston down. Unlike the four-stroke engine, the two-stroke engine lets the old gas and air out and the new gas and air in at the same time. Then, the cycle compresses the new air, and so on. (Figure 3)

The Cooling System

The cooling system cools the engine's temperature after the gas and air combust.

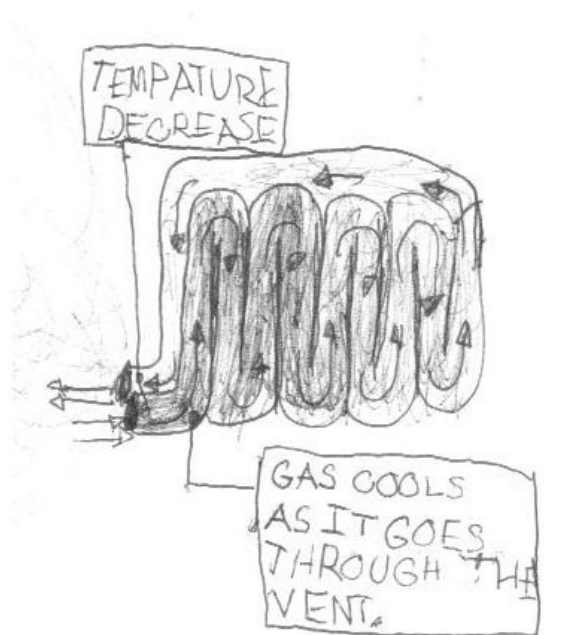


Figure 4

But that is not nearly enough to cool its 3000° Fahrenheit. Anyone near the exhaust pipe would get hurt badly. When a gas expands, it also cools. A part called a muffler provides

a path for the exhaust through a maze of pipes to get out and expand. The muffler also reduces some of the harmful waste left by the engine. (Figure 4)

History

The first true internal-combustion engine was made by the Reverend W. Cecil from England in 1820. When he went to get a patent, the judges thought it was a joke; Nothing had been better than a steam engine for a long time. They thought he was just some kind of spy setting up a prank to upset the England modernism. But when Cecil turned on the contraption, the judges were amazed at how powerful the machine actually was. It was only 5% efficient, but it could lift heavy things twice as fast as a steam engine could do to lighter things. Plus, the steam engine had to be constantly fueled. It depended more on the power of the men shoveling the fuel than the power of the engine itself. But Cecil's engine was expensive. Thus, the steam age continued. That exact engine was lost a long time ago, but we know it was the beginning of the internal-combustion engine revolution.

Exploding fuel on the inside of an internal-combustion engine does not make any difference in the amount of power generated from exploding fuel on the outside like with the steam engine. So another man named William Barnett from France invented a simple engine much like Cecil's in 1838. He hooked it up to his carriage, unhitched the horses, and made a short trip around Paris. After that, many engines were sold for a huge variety of reasons. Now, powerful jobs all around the world could be done without

horses or cattle.

In 1862, another Frenchman named Beau de Rochas invented an engine, but never got around to making it. Later, two Germans named Otto and Lagen made one with adjustments and gained their patents in the U.S. in 1876.

Otto Lithanel

The first four-stroke engine was built by Otto Lithanel of Germany. He was originally a business man, but one day he read in the paper about Beau de Rocha's engine. He discovered all kinds of flaws in it, and was so disgusted with the bad design that he decided he would have to make an engine of his own for people to see something really powerful. The engine he made worked great, but not great enough. His experiments scared him so much that he decided to give up working on engines for the rest of that year. He left his ideas alone in his shed until 1864 when another successful businessman, also from Germany, named Eugene Lagen came along and fixed up Otto's engine even more. Once Otto saw the thing working as he had planned, he wanted to start a business. But Otto barely had any funds, since he was not nearly as successful as he was before he started working on engines. However, Lagen, who was rapidly getting more and more interested in the engine, was still the cream of the heap in business. He could raise enough money in a month. Once Otto brought up the idea, Lagen did that. Then in March 31, 1864, the first internal-combustion engine manufacturing business was born.

In 1876, they won a gold medal in Paris with their design. The entry Otto made was not very impressive, but the engine itself was what got them the prize. After everything quieted down, they moved their plant to a quiet suburb in Cologne.

Otto worked as hard as he could to get the two-stroke engine up and running. For some reason, the two stroke engine would only give out about 3 horsepower. Then Otto remembered his earlier experiments with the four stroke engine. The two stroke engine did basically everything that the four stroke engine did, but all in two strokes. The faulty two stroke engine did it all too quickly. The way Otto figured, the four stroke engine would always be superior in power over the two stroke models.

The new four-stroke models would permanently dominate all of the engine models of Otto's time. The two cycle models, Otto decided, would not be good enough for cars since they were only necessary when low cost was needed and not power. However, one of Otto's co-workers, a man named Gottlieb Daimler, did not agree. He left the company to start his own business. After that, Otto and Lagen Co. got less popular because people thought that Otto should think more about other people's thoughts.

Meanwhile, Daimler was getting better and better at his company. He had developed the first engine made to burn on only gasoline the same year another German named Karl Benz introduced the same thing. Both are very similar to the models that used in cars today.

American Engines

By now, America had finally caught on to the idea of the engine and was gaining on Germany. But not everything starts off with something big. The first all-American car was the “Durya” made by Charles and Fred Durya in 1892. By 1896, they had sold and manufactured 13. (But now there are only 12, since one ran into a bicycle and its wheels fell off.)

Although America had a start by the 1900s, it was warded off by the monstrosity of sound that it made when it was turned on or when it did hard work. But then research found a way to muffle it in 1903.

Henry Ford

In 1896, another man named Henry Ford got started in the engine manufacturing business when he invented his quadricycle car named after its bike-like tires. He built his first engine in 1893 when he was thirty. He started the Ford Motor Company in 1903. Then he invented a race car for a race that would be held just outside of Detroit. A Cleveland aristocrat car manufacturer had entered the race. But his car was slow and had very little turning capabilities. Henry won the race easily. After that he became quite popular.

Later in 1908, Ford invented the Model-T, a simple but sturdy vehicle. After that, he was popular all over the world. He soon sold well over 10,000 of them. Then, since they were such a great success, Ford decided He would only be selling the model-T until something better came out or he had another good idea. But the original price was a

whopping \$825. He lost money, because only rich and higher than average people could afford something that expensive. Ford acted fast and put in conveyor belts and put hundreds of workers along them. Each worker did a small job like tightening bolts or snapping together two parts so that no time was wasted. Now, what used to take twelve hours of work could be done in one hour. This cranked up the “cars-per-day” rate from 15 cars per day to 21. Ford built up his money and started making his own parts, glass, and steel. He also started to sell parts, which got him even more money on the side. The Model-T's selling price got lowered to \$550. Still a long way to go, but the price kept going down. It then dropped down to \$290 in 1930, putting it into everybody's reach. Then he raised minimum wages to \$5 a day. He also narrowed working hours down to 8 hours a day. Now even low-class people and immigrants could get money easier without having to have a dirty, ratty environment or huge amounts of knowledge. When room for workers started to get scarce, he remodeled the factory so he would produce more cars in a day, and so lots more workers could come.



Henry Ford

Henry Ford's political affairs were not nearly as good as his ability to sell cars. Once, Ford had 120 people illegally in England seeking peace by opposing war with Germany during World War II. Then, Henry ran for president as a Democrat and lost. But in 1964, he made the Ford Foundation, raising money

for research, and education.

Ford II

In 1927, Ford made his Model-A, which was the cheapest, most powerful, good looking car around. But by then it was too late, and GM had taken the lead of the car industry. Then in 1945, his sales dropped and he couldn't seem to get them back up again. He quickly started to make military supplies so that he could pull his grandson, Henry Ford II to the top of the business. And he did.

Poor Henry Ford II would go bankrupt and be blamed for it all because of Henry I. Henry II had to act fast to try to prevent all that from happening. He was now losing \$9,000,000 a month. Bankruptcy was rapidly approaching. Ford quickly hired experts to whip the company back into shape. That cost him a lot of money, but at the end of the reorganization, he gained \$112,000,000. More models like the Thunderbird, Falcon, and Mustang helped the company to boom.



Henry Ford II

Conclusion

The internal-combustion engine has greatly benefited the modern life. Research is constantly finding improvements that make it more efficient and better overall. This report is just a small glimpse of all there is to learn about the engine. It started with the Reverend



W. Cecil, but the first huge boom was started by Otto and Lagen, followed by Dalmier and Charles and Fred Durya, then Henry Fords I and II. The internal-combustion engine built up slowly, but despite all that, it really got huge. I really enjoyed doing this report and hope you enjoyed reading it. Happy motoring!

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