Science of the Model A — Gasoline

BY HOWARD EXTEND

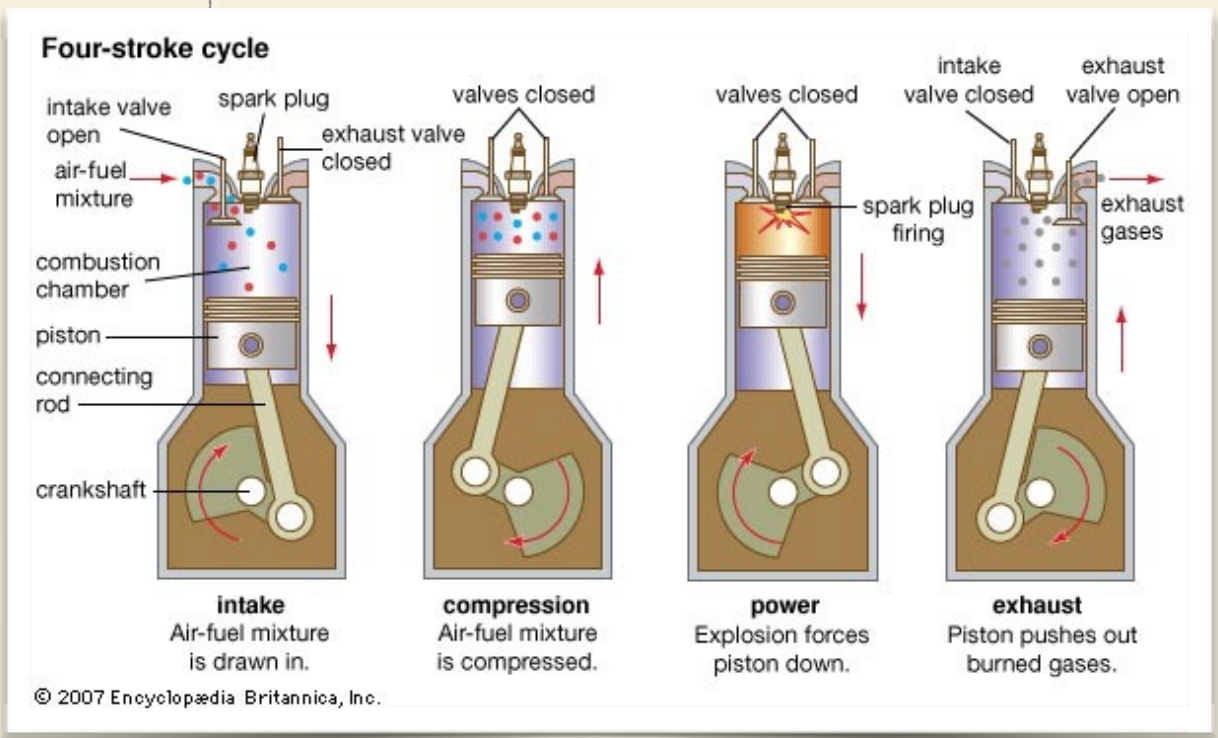
Q. What is the role of gasoline in our cars?

A. Gasoline, when mixed with the right amount of air becomes an explosive. The engine is so designed as to capture the energy of this volatile mixture to produce the power that propels the car.

Gasoline is made from crude oil. By cooking crude oil at different temperatures, a process called cracking, refiners can produce methane which is a light gas all the way down to tar which is a heavy solid. In between methane and tar, gasoline is distilled from the crude.

The gasoline you buy is made of liquid solvents containing molecules of carbon and hydrogen. Additives are blended into gasolines which have certain properties that help engines perform at higher efficiencies.

The process of combustion of gasoline in the Model A engine starts with fuel being atomized and mixed with air in the carburetor. This mixture has to be precise to get the best performance and fuel economy. The ratio is usually about 14.7 parts air to 1 part gasoline.



As the air/fuel mixture is being created, it is inhaled by the engine as a piston goes down in its cylinder, creating a partial vacuum. After a charge of fuel-enriched air is in the cylinder, the valves that let it in and let exhaust out are closed and the piston moves up to compress the air/fuel mixture at a ratio of 4 to 1. Compressing the volatile air makes it even more explosive, thus increasing the energy available in the combustion. All it takes is a little spark to set it off.

At just the right time, the spark plug is fed high voltage electricity causing a spark to form between its electrodes which ignites the gas and air mixture. The rapidly expanding gasses of combustion have to go somewhere and the only thing that can move out of its way is the piston which is forced downward, transferring the energy of combustion to the crankshaft. One of the additives in gasoline is designed to make the air/fuel mixture burn slower than just a raw explosion. By slowing the combustion, power can be released throughout the downward stroke of the piston. In addition to being more efficient, it is also easier on the engine components in that they are not exposed to such shock during combustion.

If compressed enough, the air/fuel mixture can spontaneously ignite. This is called pre-ignition. This interferes with our control over the timing of when we want the spark to set off the combustion. Ethanol, which today is used as an octane additive, changes the ignition point of the fuel so that compression alone does not ignite it. The measure of a fuel to resist pre-ignition caused by compression is called its octane rating. Modern engines run at about 8 to 1 compression and need higher octane fuel to prevent pre-ignition or "engine knock". With its 4 to 1 compression ratio, the Model A engine can use any regular grade of gasoline. The lowest octane rating available today is sufficient for our old cars.

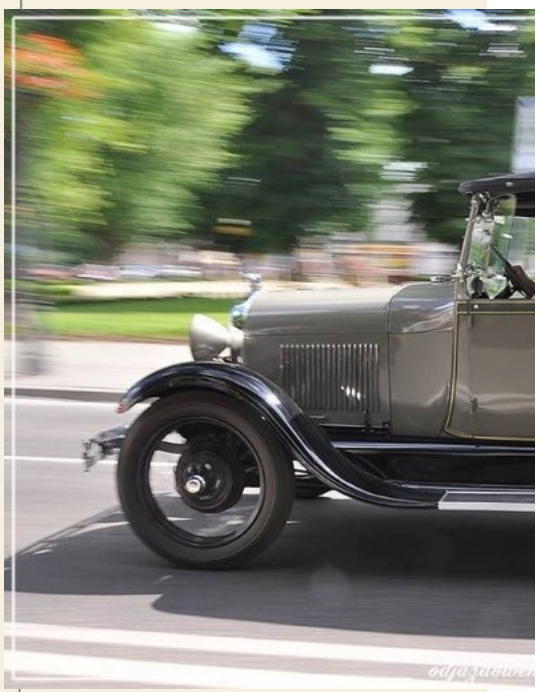
Starting in the 1920s, tetraethyl lead was used as an octane additive in gasoline. Lead was used to help prevent damage to the valves due to the heat of combustion. The flame temperature of combustion in our engines is around 4000°F. Aluminum, from which Model A pistons are made, melts at about

1220°F. Cast iron from which the engine block is made melts at about 2190°F. Without oil and coolant, our engines would soon weld themselves together. Lead is good at preventing damage to valves, but does not burn, thus exiting with the exhaust, creating a public health problem. Its use was phased out in the U.S. beginning in 1975 and banned in 1996. Modern engines are made with harder valve seats and different alloys for valves that work well with lead free gasoline. We needn't worry too much about unleaded fuel in our Model As. We simply don't run them enough to see a significant negative effect.

The byproducts of combustion include carbon and water. Carbon can easily deposit itself on the interior surfaces of the engine causing problems such as pre-ignition. Major gasoline brands have detergent additives which help to prevent carbon build-up in the engine. Water exits with the exhaust as super-heated vapor and eventually leads to rusting out our mufflers and tailpipes.

The amount of potential energy in a gallon of gasoline is measured in BTUs or British Thermal Units. Straight gasoline has a BTU rating of about 114,000. Ethanol has about 76,330 BTUs per gallon. Thus gasoline with 10% ethanol mixed in is less efficient than straight gasoline. In The U.S., most retailers are selling fuel mixed with ethanol. This is why your Model A seems to get worse gas mileage than you remember getting years ago.

Gasoline is more than just the go-juice you complain about paying too much for. The chemical engineering that has developed the fuels of today for the modern cars we drive is just fine for our Model As. So buy some gasoline and take your Model A for a spin today.



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