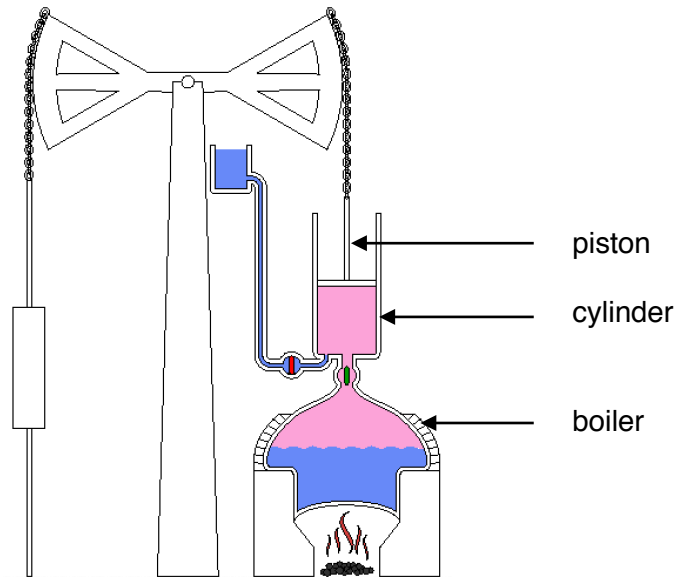
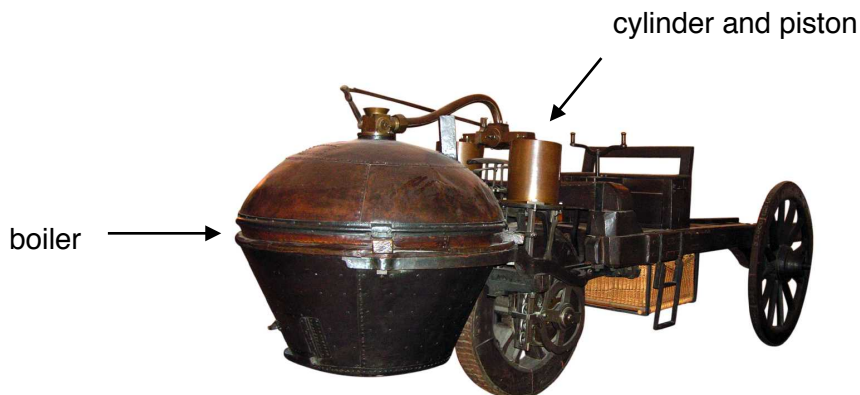


F. The Second Power Revolution, Part 1: Oil

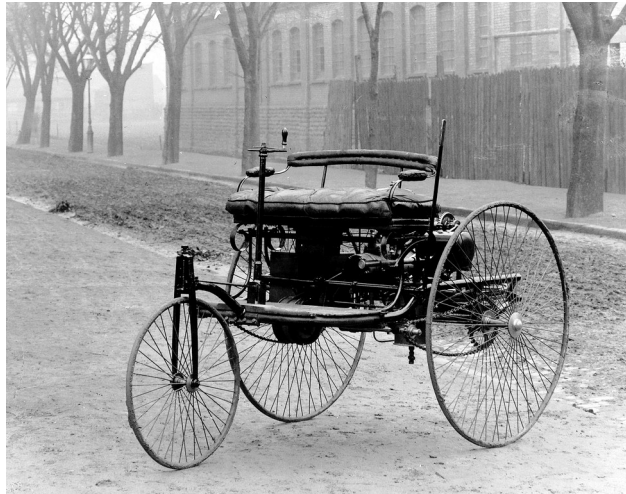
1. Steam engines could never have been used in cars and planes because they are too large and heavy. A steam engine gets its power from a vessel called a “boiler” in which water is boiled to create steam, usually by burning coal. The pressure created by that steam then enters the “engine”—a cylinder in which pressure changes move a piston, as in the diagram of a simple steam engine below.



2. Steam engines are sometimes called “external combustion engines,” because the burning of the fuel is done outside the engine itself, in the boiler. If a car had such an engine, it would look something like this:

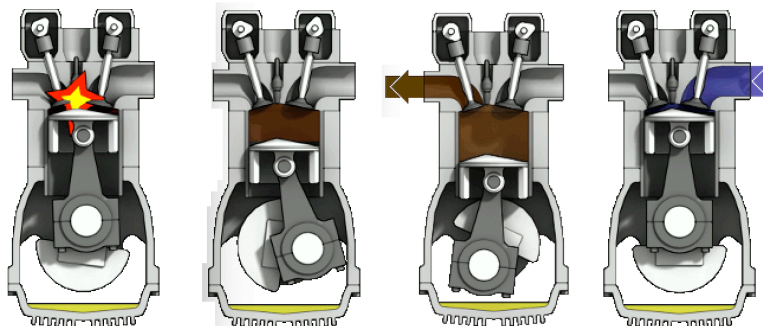


3. By contrast, “internal combustion engines” are much smaller and lighter.



The first Mercedes Benz - 1885!

4. They are called “internal combustion engines” because gasoline is burned inside the cylinder of the engine, which creates a lot of power!



Little explosions inside your family car 30-50 times per *second* are what let us move down the road so quickly!

5. Small and light engines were needed for the first airplane, flown by the Wright Brothers in **1903**, and then in automobiles like the Ford Model-T, which started being made in **1908**.
6. Meanwhile, another kind of power was also being invented!

G. The Second Power Revolution, Part 2: Electricity

1. The ability to make electricity is what allows us to have lightbulbs, refrigerators and televisions, among so many other things!
2. Many of these inventions are based on the science of “electro-magnetism,” which has to do with electricity and magnets, and how they work together.
3. The first useful communication device based on electro-magnetism was the telegraph of **c.1837** by Samuel Morse, which used “Morse code” to send a electricity along a wire over great distances.
4. Later, electricity was used by amazing inventors, such as Alexander Graham Bell, who invented the telephone **c.1876** and Thomas Edison, who invented the light bulb **c.1879**.
5. Making electricity at power plants became possible **c.1882**—which provided enough to light the cities and homes of the world!
6. Who can even begin to calculate what new wonders were created because inventors could work through the night in well-lit laboratories and offices from that point onward?!



Alexander Graham Bell makes his first famous public telephone call in **1876** (left) and Thomas Edison shows off his lightbulb in **1879**.