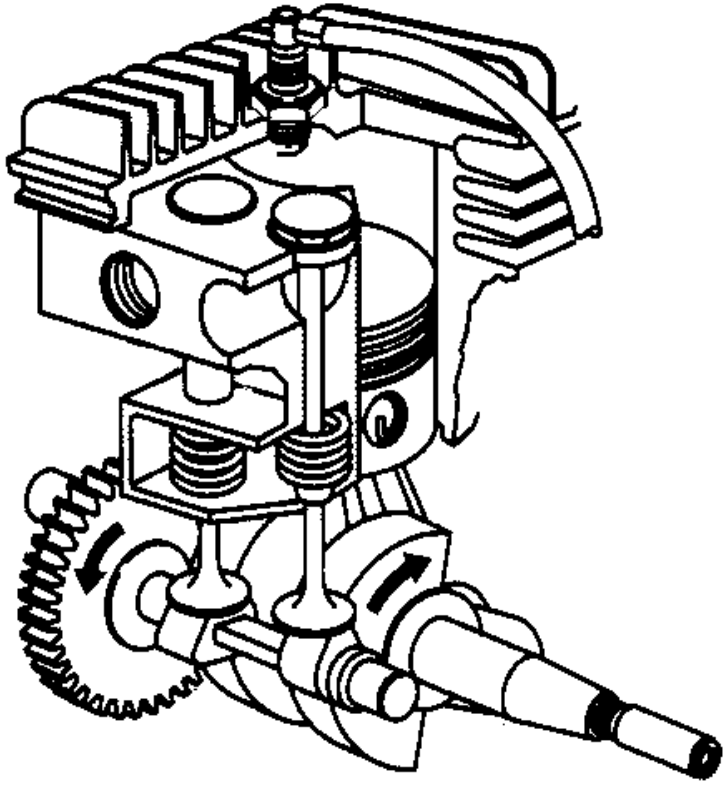
Engine Project



(ref. 2, Used by permission of Briggs and Statton, ©1992, all rights reserved)

Your team is going to dissect and assemble a 3.5 HP single cylinder, 4 cycle engine, made by Briggs and Stratton in Milwaukee, Wisconsin

These engines are typically used in lawn mowers, snow blowers, go-carts, etc

Engine Project

- Start engine.
- Disassemble engine. (Follow the instruction exactly!)
- Review parts and functions – Ask questions!
- Answer questions about engines. (group assignment)
- Reassemble engine.
- Re-start engine.
- Write individual report on how engines work. (individual assignment)

What is an engine?

- a machine which converts chemical energy into mechanical energy

Types of engines:

*External combustion engine.

-Ex: steam engine

*Internal combustion engine.

-Ex: car engine

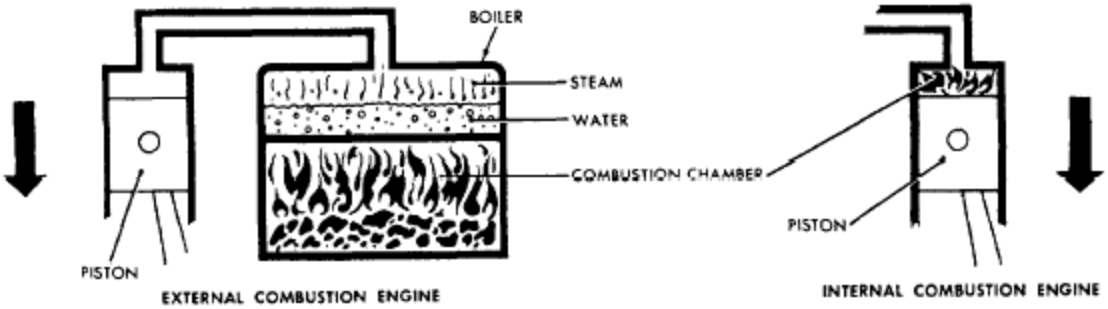


Figure source:http://www.tpub.com/machines/12.htm

Internal combustion engines

- Reciprocating engine
  - 4 stroke engine
  - 2 stroke engine
- Rotary engine
  - Wankel engine
  - Turbine engine
- Reaction engine
  - Rocket engine

The very basic of an engine

- **The ideal gas law: $PV = nRT$**

  P: pressure; V: volume; n: mole number; T; temperature

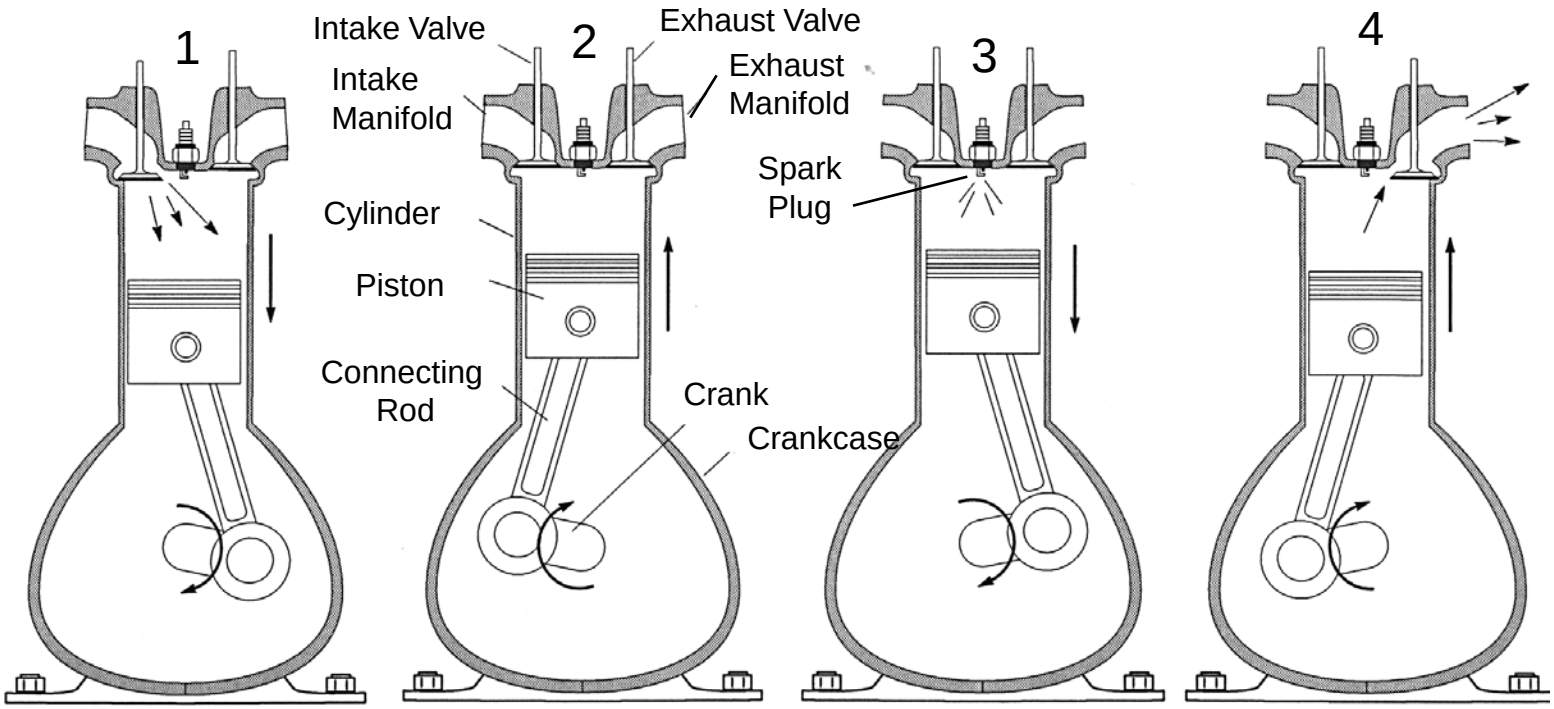
  - Gas will expand upon the application of heat.

  - The application of heat upon the gas will increase its pressure (if gas is confined in a volume).

  - The compression of the gas will increase its temperature

We try to create heat (through burning) to the gas, so the gas can push the piston, thereby cranking the engine, and output the movement to useful work.

4 stroke Cycle

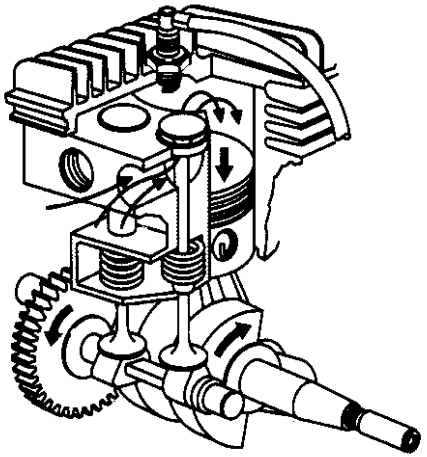


Intake Stroke
Intake valve opens, admitting fuel and air. Exhaust valve closed for most of stroke

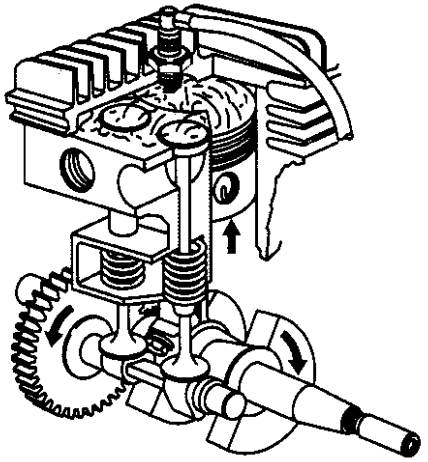
Compression Stroke
Both valves closed, Fuel/air mixture is compressed by rising piston. Spark ignites mixture near end of stroke.

Power Stroke
Fuel-air mixture burns, increasing temperature and pressure, expansion of combustion gases drives piston down. Both valves closed - exhaust valve opens near end of stroke

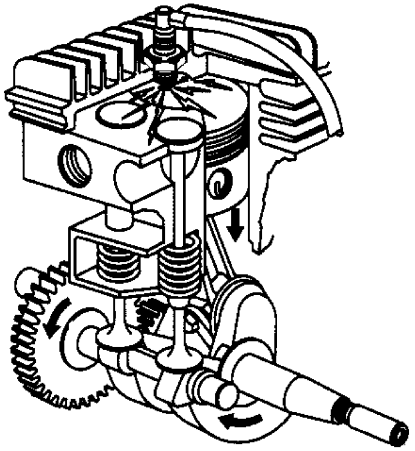
Exhaust Stroke
Exhaust valve open, exhaust products are displaced from cylinder. Intake valve opens near end of stroke.



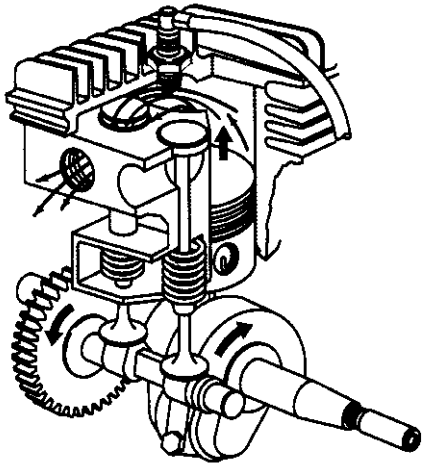
1. Intake



2. Compression



3. Power



4. Exhaust

Animation

Questions:

1. How do we have the mixture of fuel and air into the cylinder?
2. How do we initiate the combustion?
3. Anything else important related to the combustion?
4. How do we out put the work into useful energy?
5. Anything else to notice?

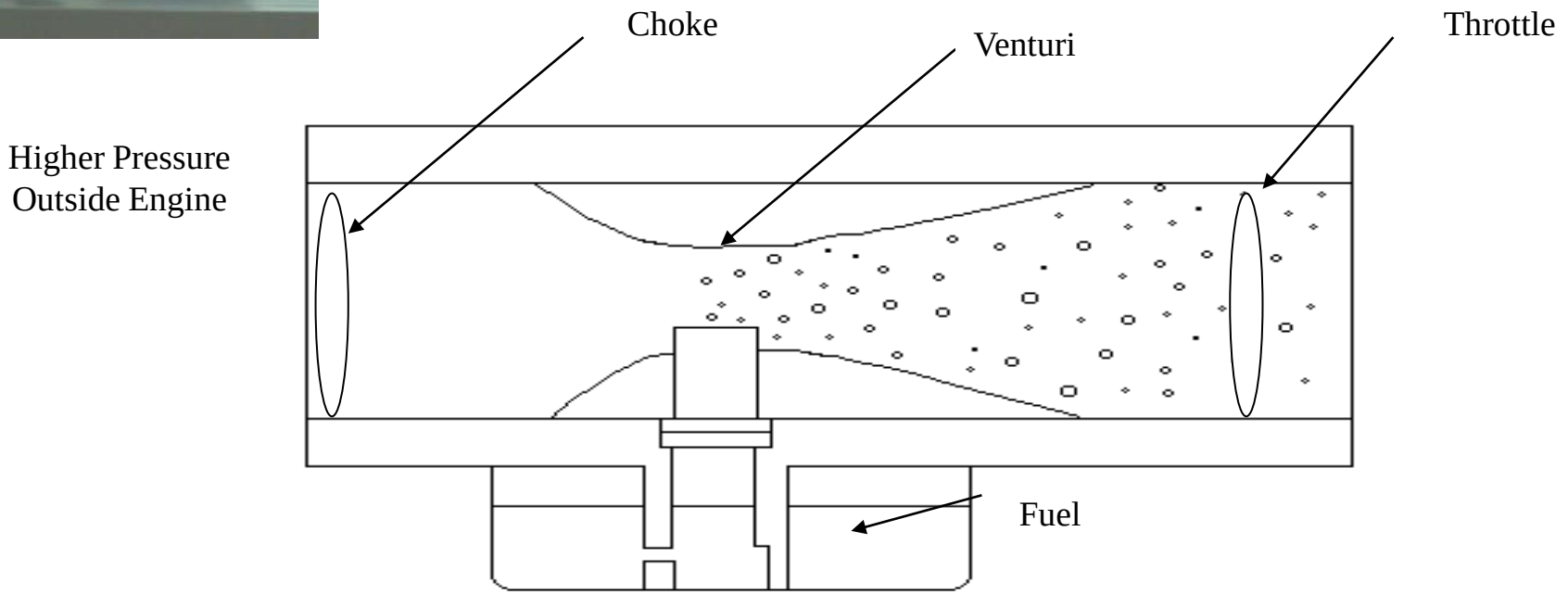
How do we get the mixture of fuel and air?

Venturi-type Carburetor

The carburetor of our engine

Bernoulli Effect:

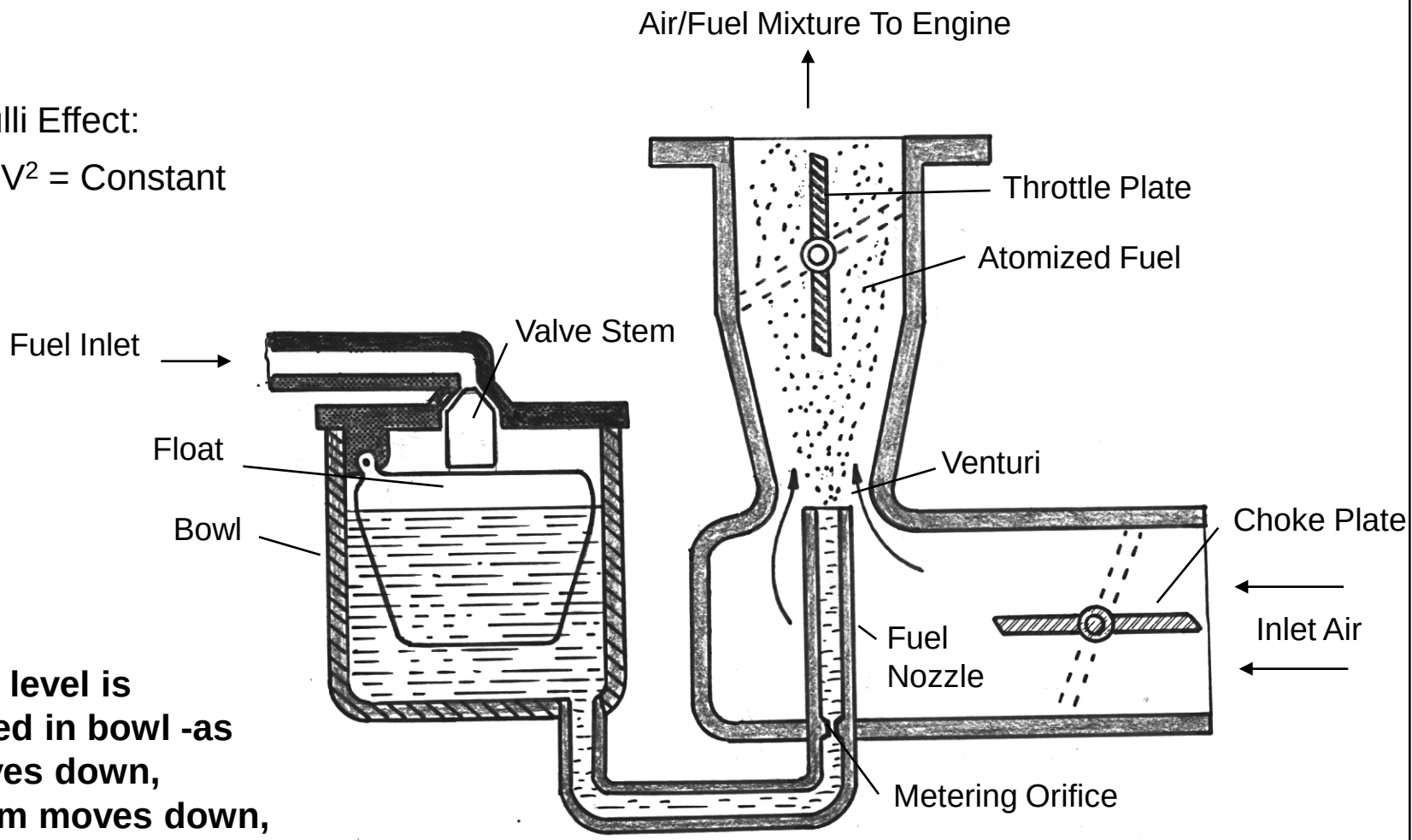
$P+1/2\ \rho V^2 = \text{Constant}$



Venturi-type Carburetor in the car

Bernoulli Effect:

$P+1/2\ \rho V^2 = \text{Constant}$



Constant level is maintained in bowl -as float moves down, valve stem moves down, allowing more fuel into bowl, float moves up and closes valve

Ref. Obert

How do we initiate the combustion?

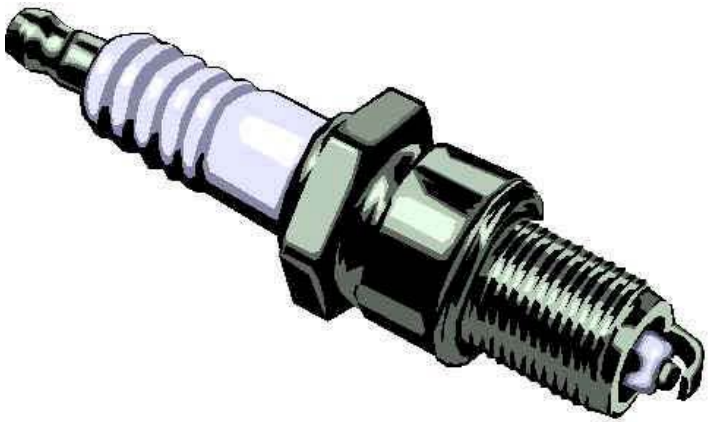


Image resource:

http://www.nhsnowmobilemuseum.com/burdicksledshed/1974%20Alouette%20Super%20Brute%20440.htm

But how do we get the spark plug *spark*?

- **Megneto system (which our engine uses)**
- **Mechanical ignition**
- **Electronic ignition**
- **Engine management system**

…….

Anything else important related to the combustion?

- **Think about following situations:**
  - **-What will happen if the intake or exhaust valve are not closed during the compression stroke (just before the power stroke)?**
  - **-What will happen if the intake or exhaust valve open during the power stroke?**

These situations are not desirable.

Need solutions to avoid these.

- Solution?

Right timing of the valves.

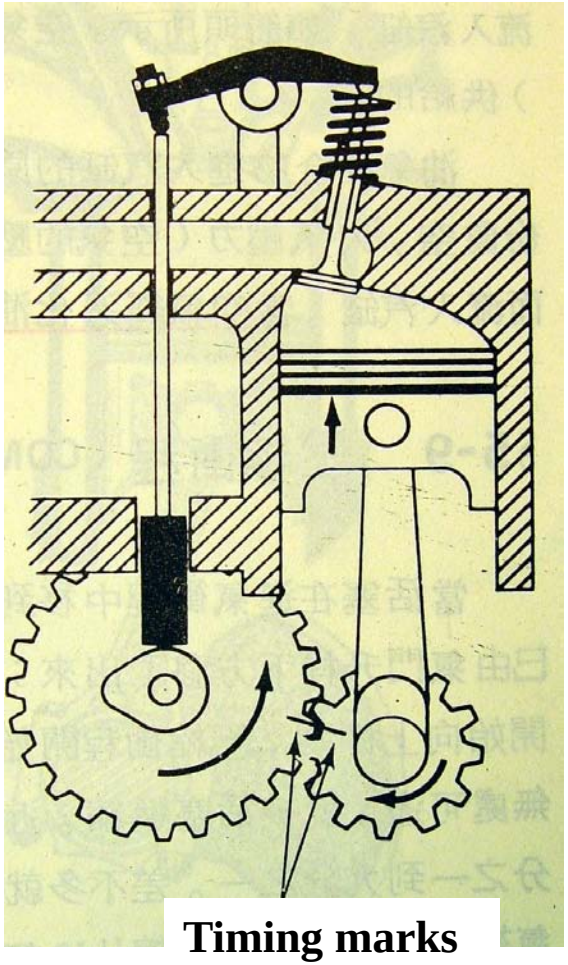
The valve mechanism.

Valve Mechanisms:

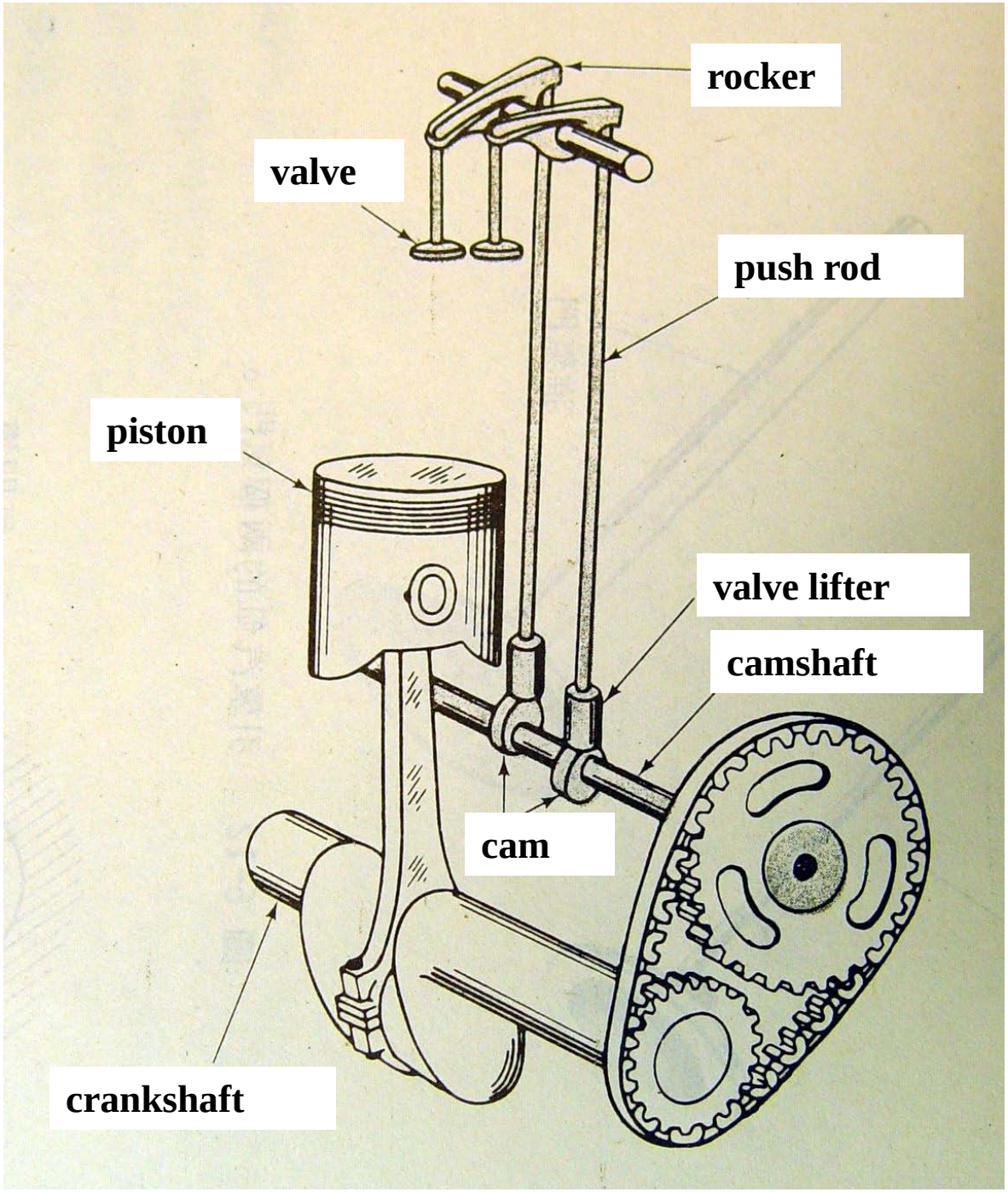
How you get the right timing

Image from :

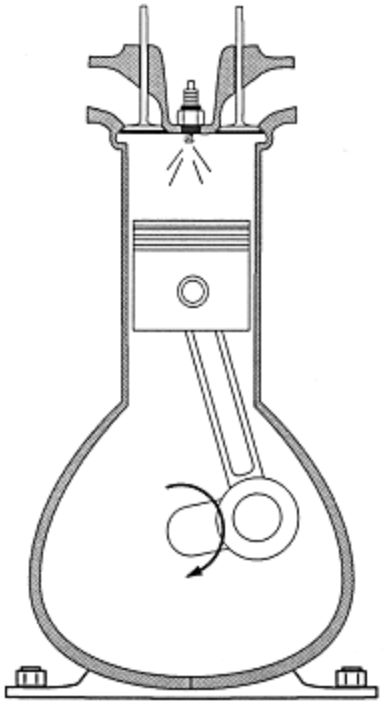
Automotive mechanics, 8th ed. By William H. Crouse



Timing marks



So now you think you can prevent all the leaking from the cylinder?



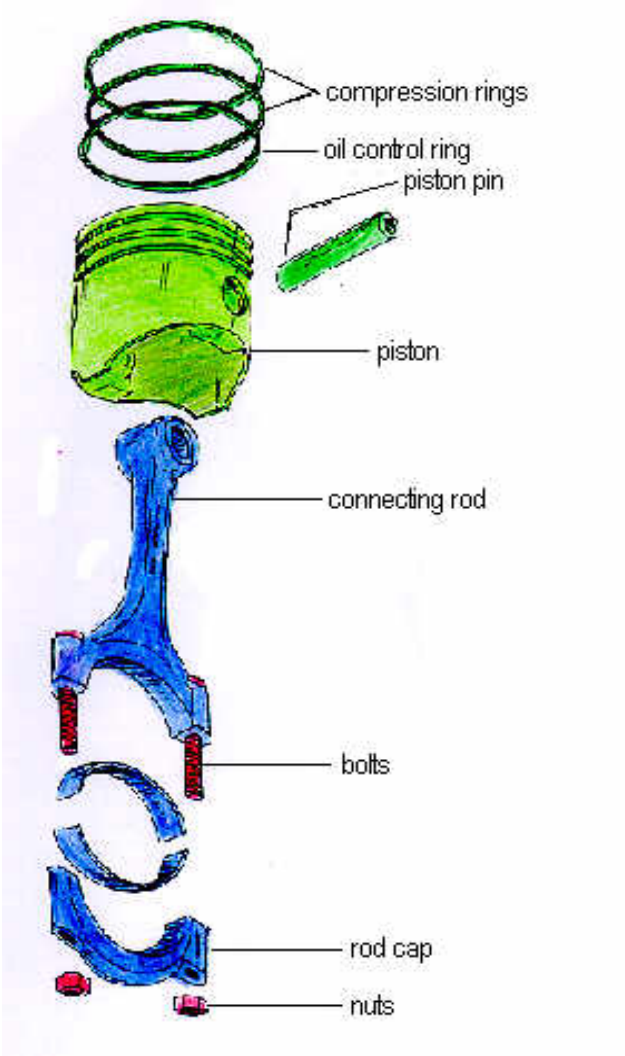
Piston

Image from:

www.rbracing-rsr.com/ 113orca.htm

darryl.hudson.home.mindspring.com/

ww.eng.iastate.edu/explorer/topics/car/engine.htm



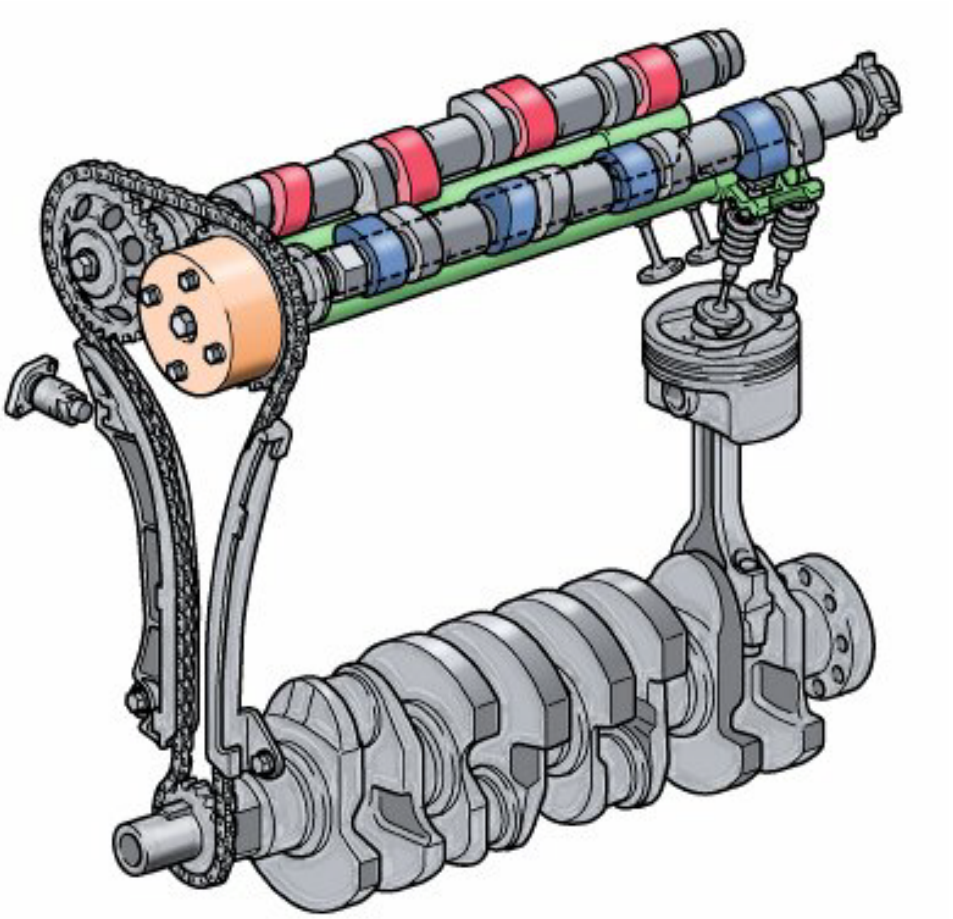
How do we output the work into useful energy?

Reciprocating to rotary motion

Crankshaft

Image from :

toyotaperformance.com/crankshaft_kits.htm



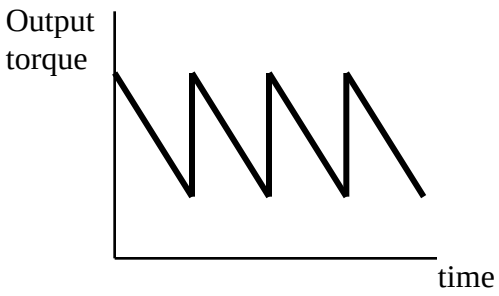
Anything else to notice?

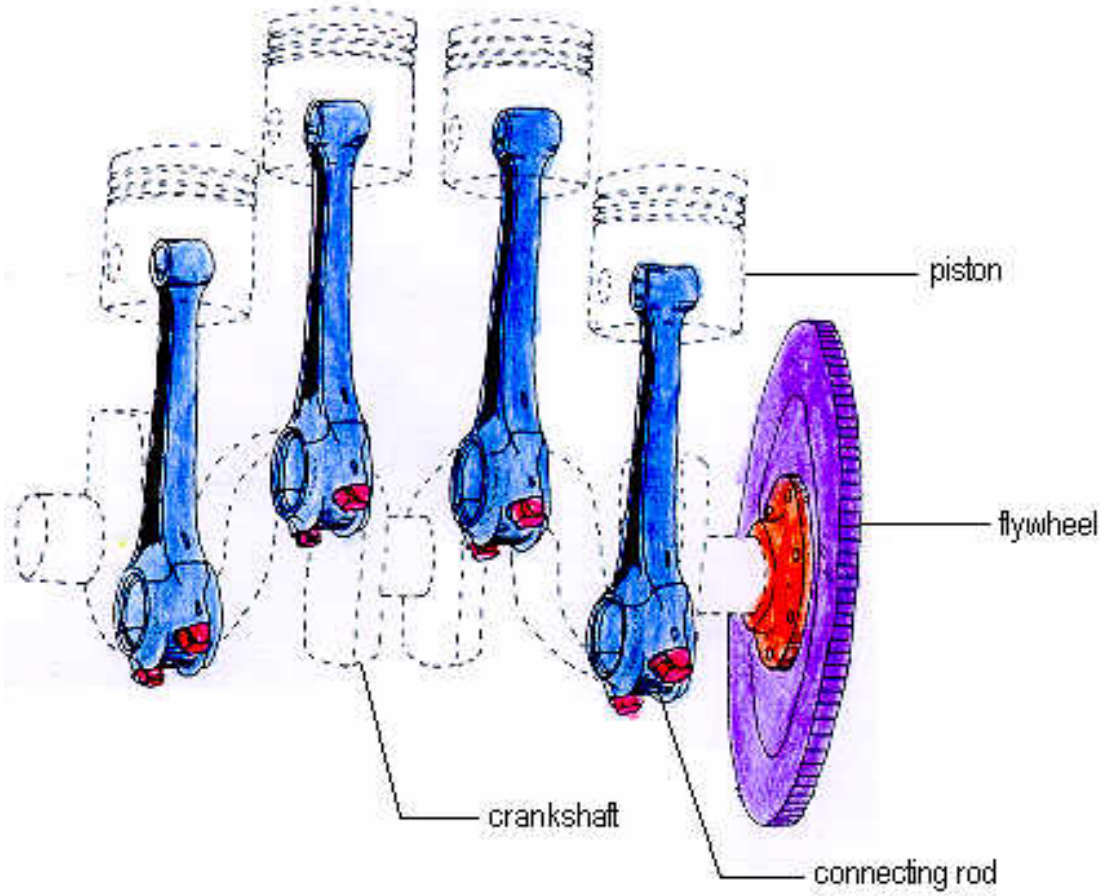
Piston, crankshaft,

& fly wheel

Image from:

http://www.eng.iastate.edu/explorer/topics/car/engine.htm





Have a better idea how engines work?

How does the engine complete these Primary Functions?

- **Get started?**
- **Suck in fuel/air?**
- **Mix air and fuel?**
- **Ignite the mixture (at the right time)?**
- **Make the combusting gases do work?**
- **Make the work available to somebody?**
- **Exhaust the gases?**
- **Shut off?**

Think about the parts and processes involved for each.

Have a better idea how engines work?

How does the engine complete these Secondary Functions?

- **Stay lubricated?**
- **Operate the valves at the right time?**
- **Smooth out the power pulses?**
- **Store the fuel?**
- **Keep cool?**
- **Make it easy to start?**

Think about the parts and processes involved for each.