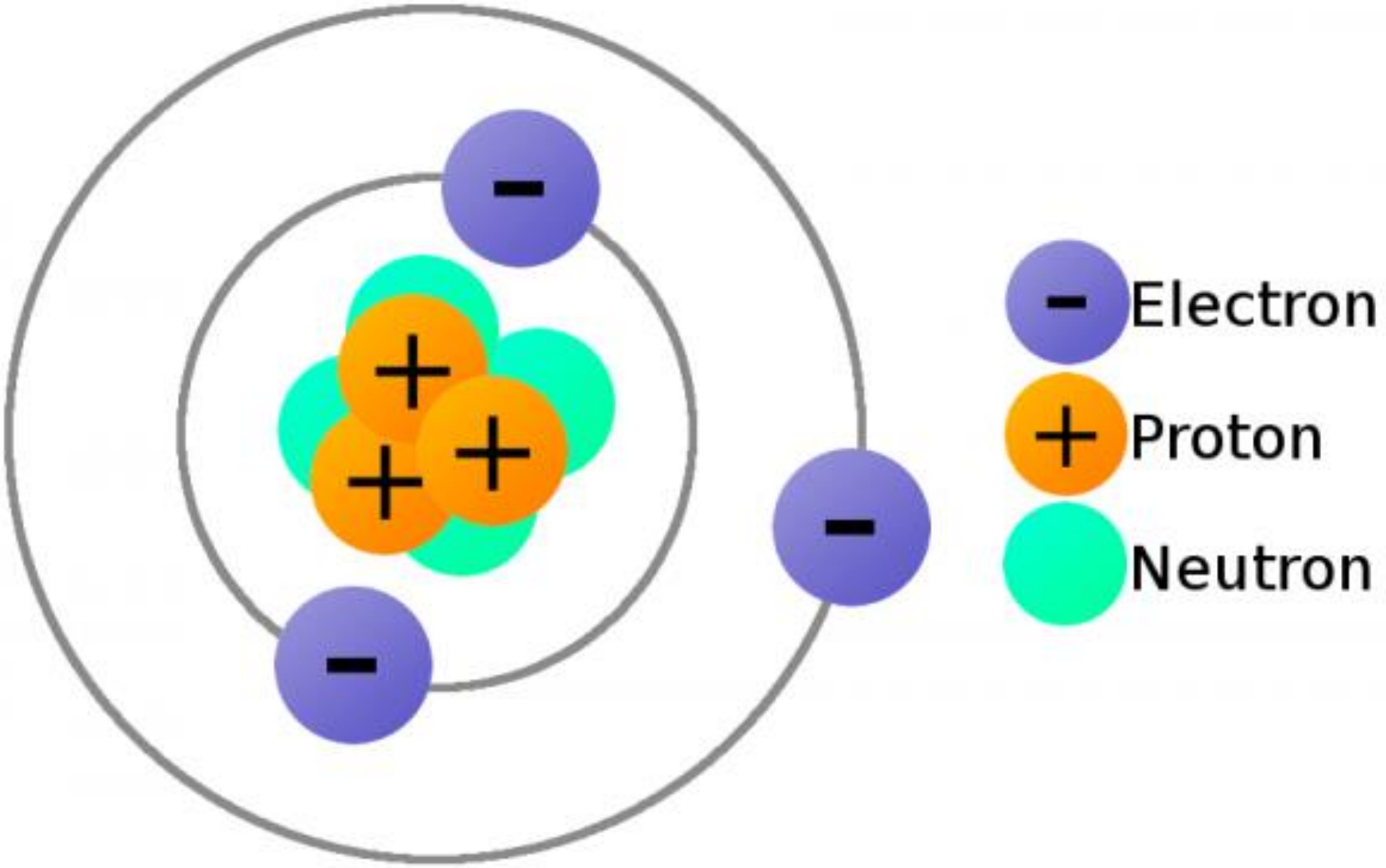
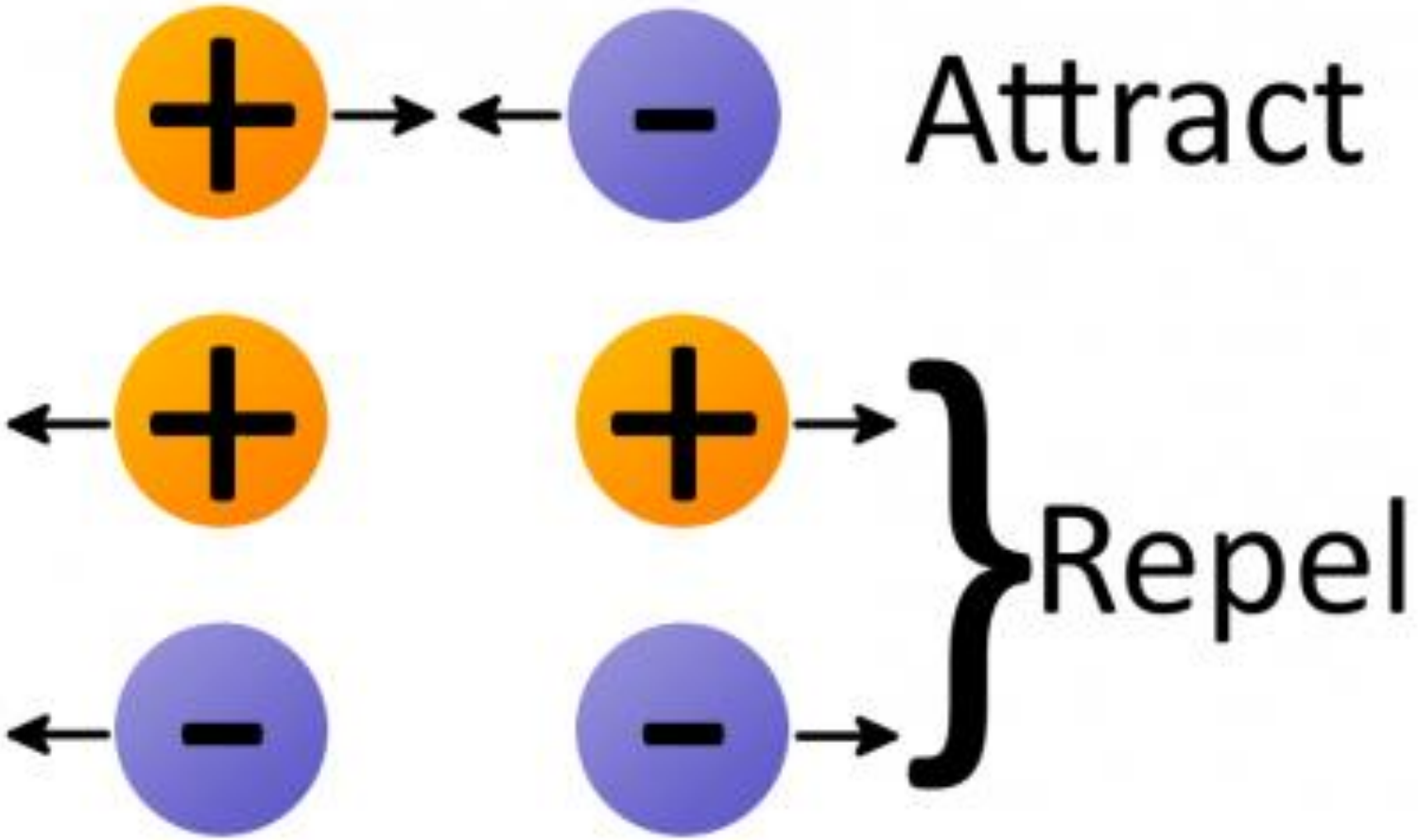
Electrical Systems

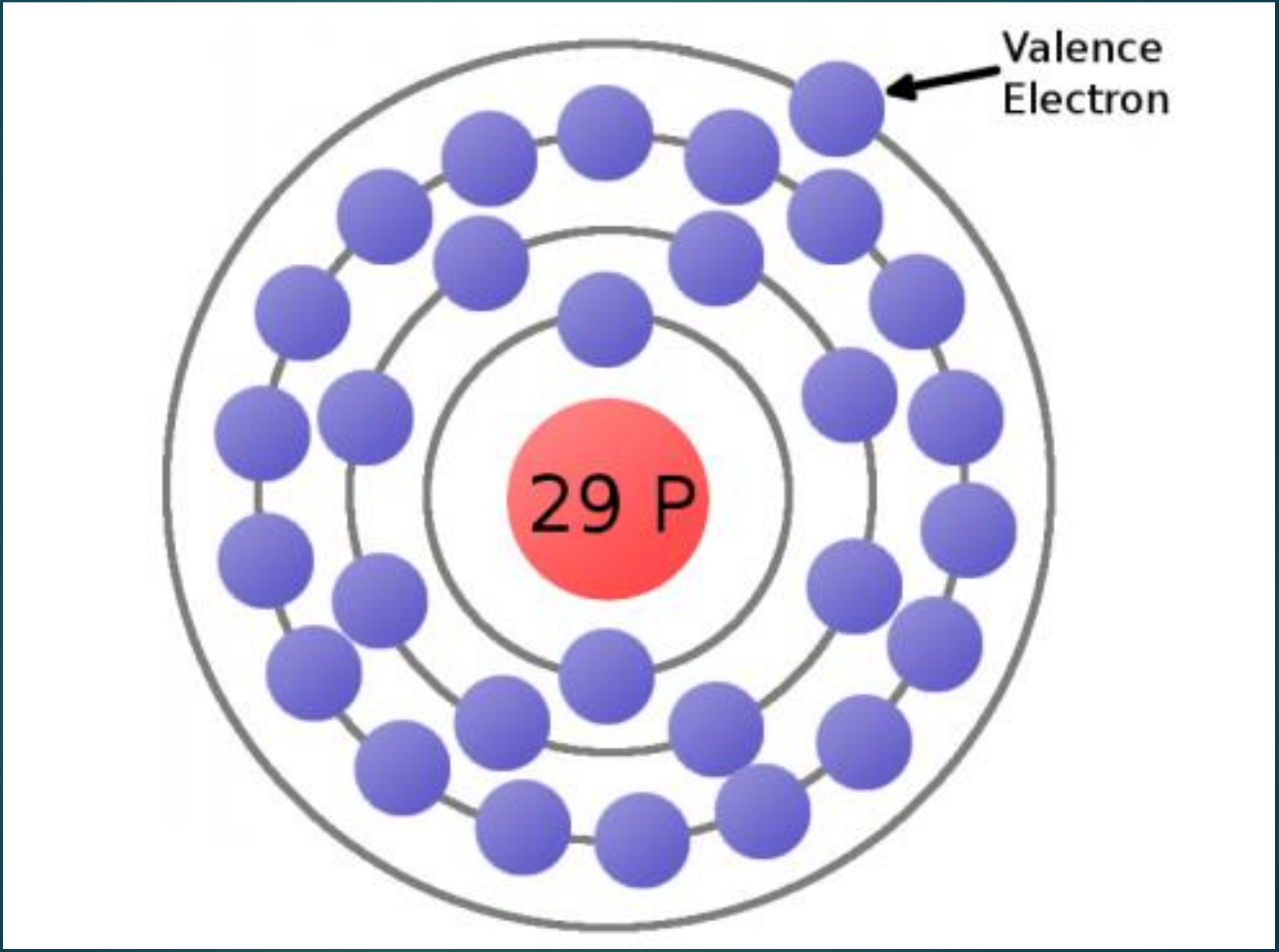
Atomic basis of electricity



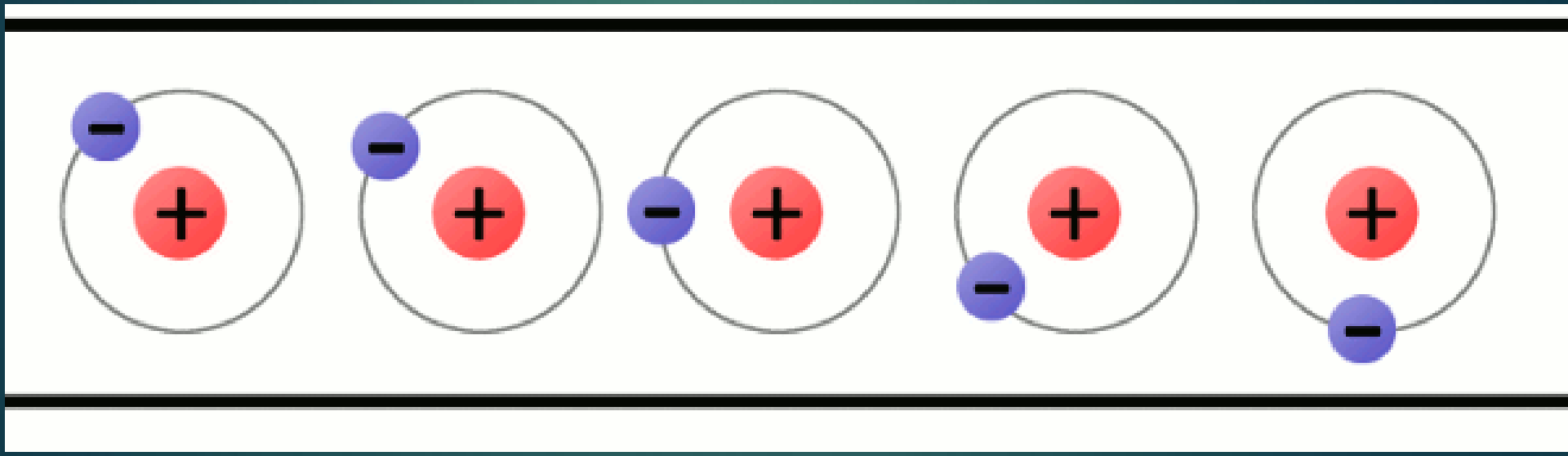
Law of attraction



Outer shell is loosely bound

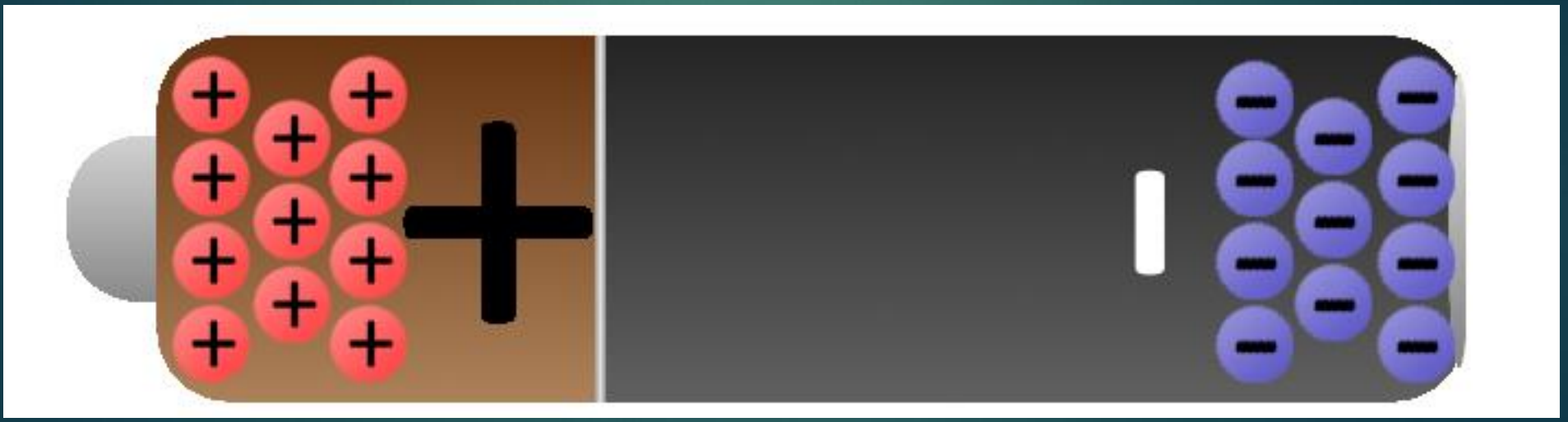


In material that is "conductive" electrons are free to flow – this is electricity



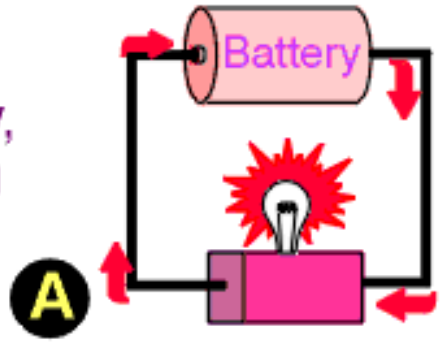
Battery

- Electrical energy storage device with segregated + and – poles
- Provides large energy burst to start engine turning
- Receives and stores energy from generator/alternator in excess of needs of aircraft's running electrical devices
- Provides power reserve in case alternator/generator fails

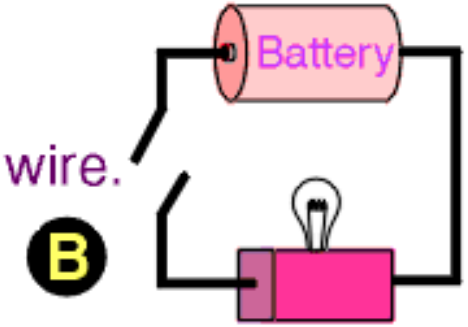


THE FLOW OF ELECTRICITY

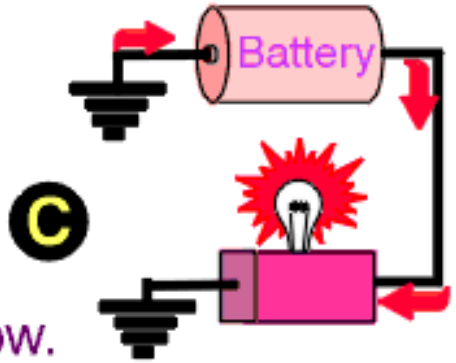
Electricity flows from one side of the battery, through the bulb, then back to the other side of the battery.



Electricity can't flow because of a broken wire.

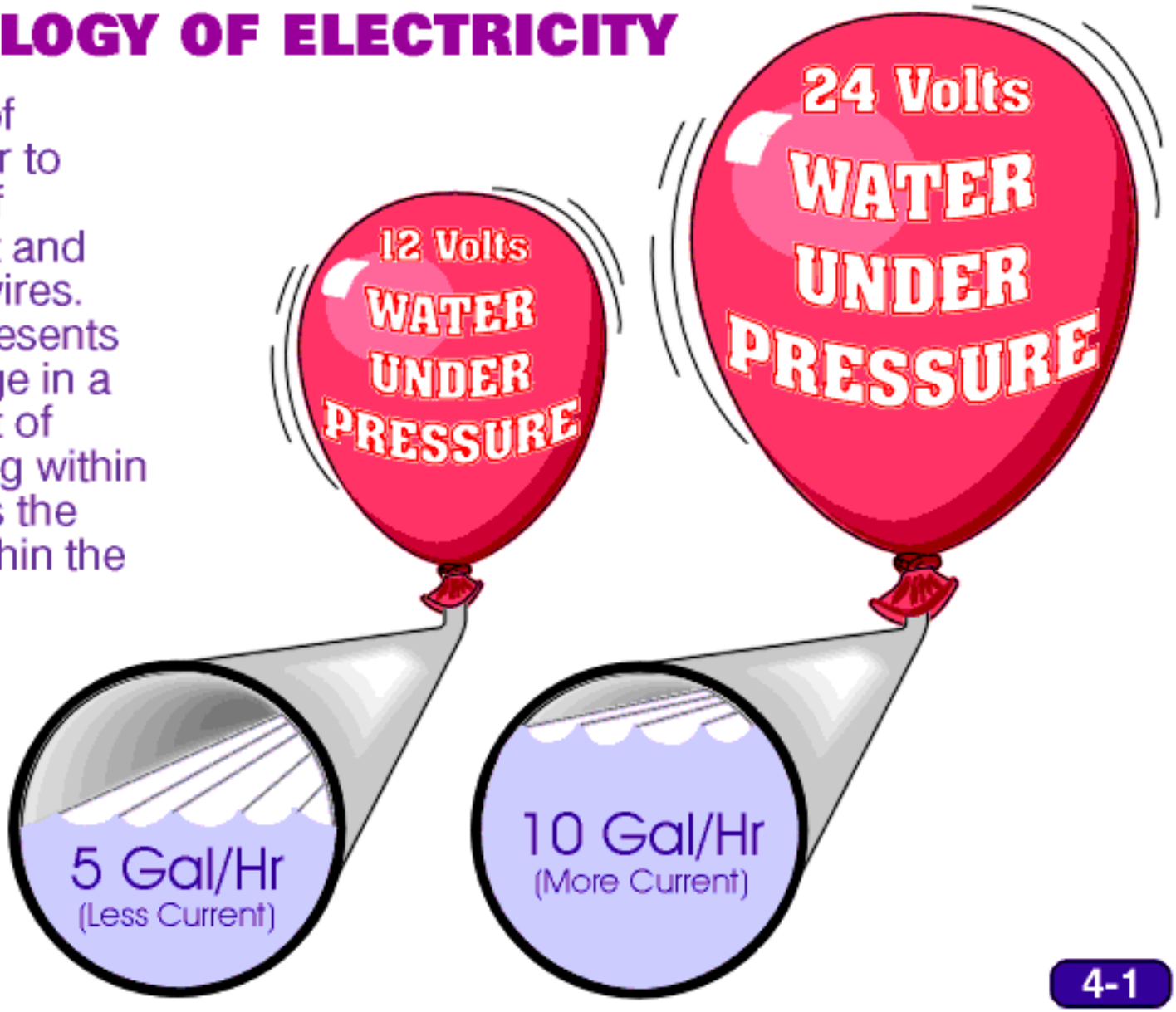


Slashed triangles indicate that an electrical conductor, (usually the metal frame of airplane), allows electricity to flow.



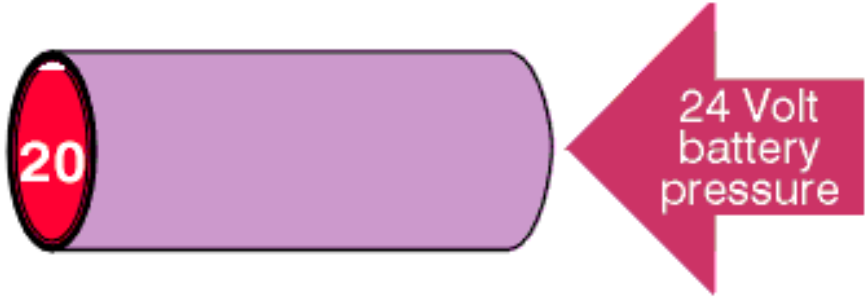
WATER ANALOGY OF ELECTRICITY

The water analogy of electricity uses water to represent the flow of electricity in a circuit and pipes to represent wires. Water pressure represents the amount of voltage in a system. The amount of water actually flowing within the pipes represents the electrical current within the system.

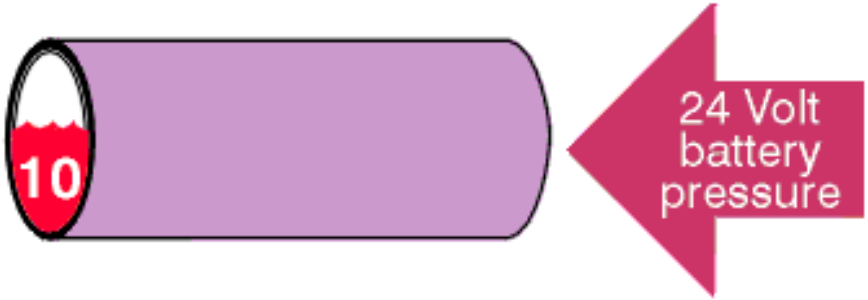


WATER ANALOGY OF VOLTAGE AND CURRENT

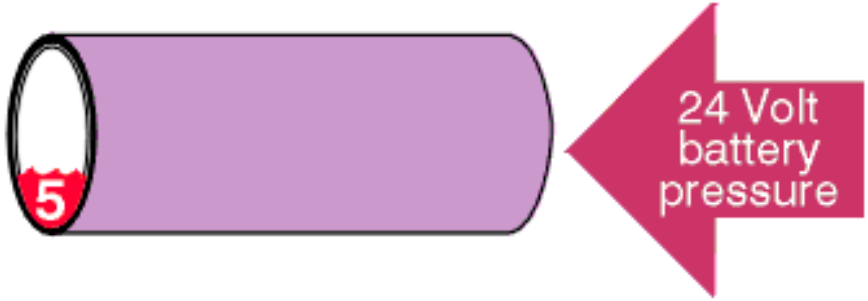
At 24 volts of electrical pressure, only 20 amps of electrical current (water) can be pushed through this wire (tube).



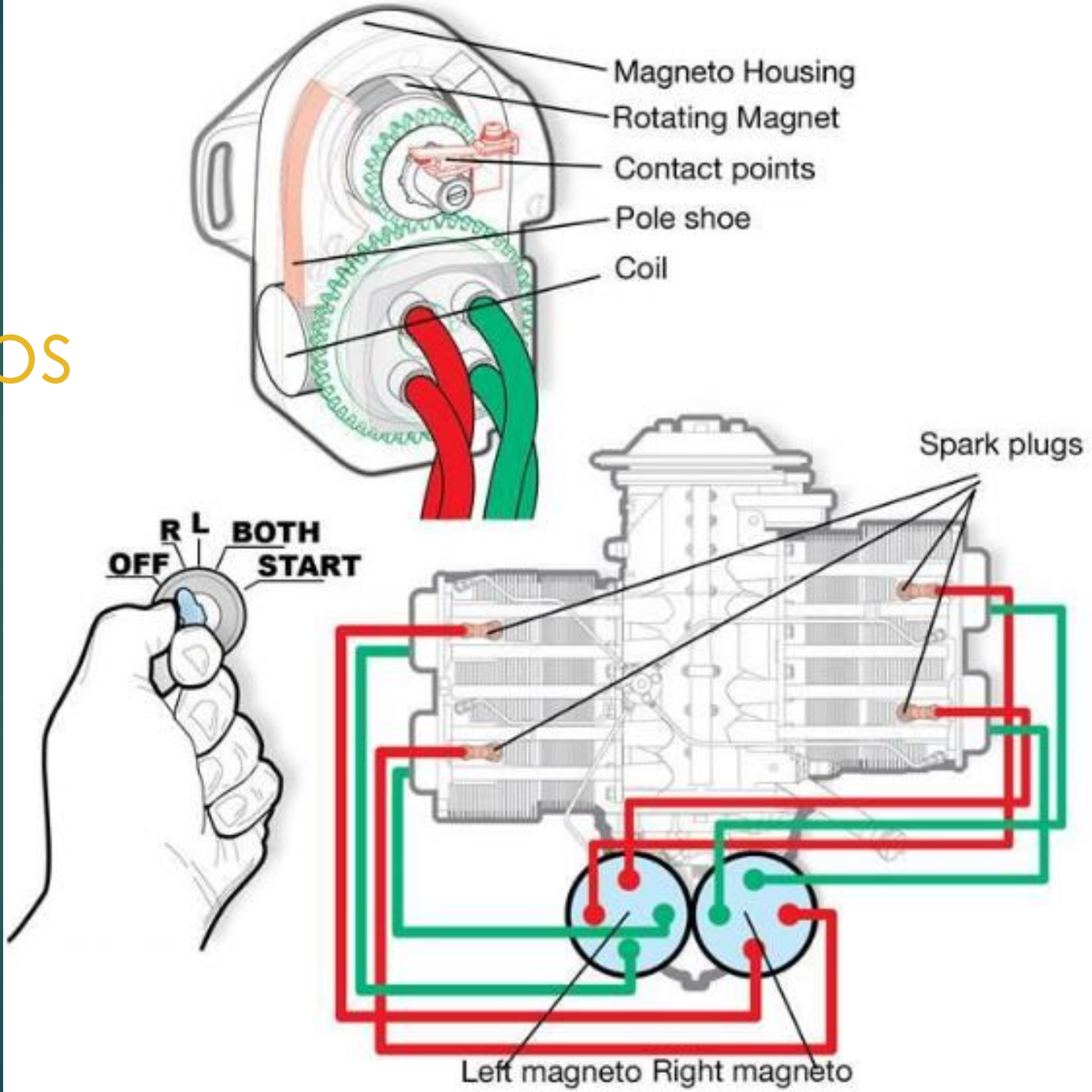
At the same 24 volts of electrical pressure, electrical equipment draws only 10 amps of current (water).



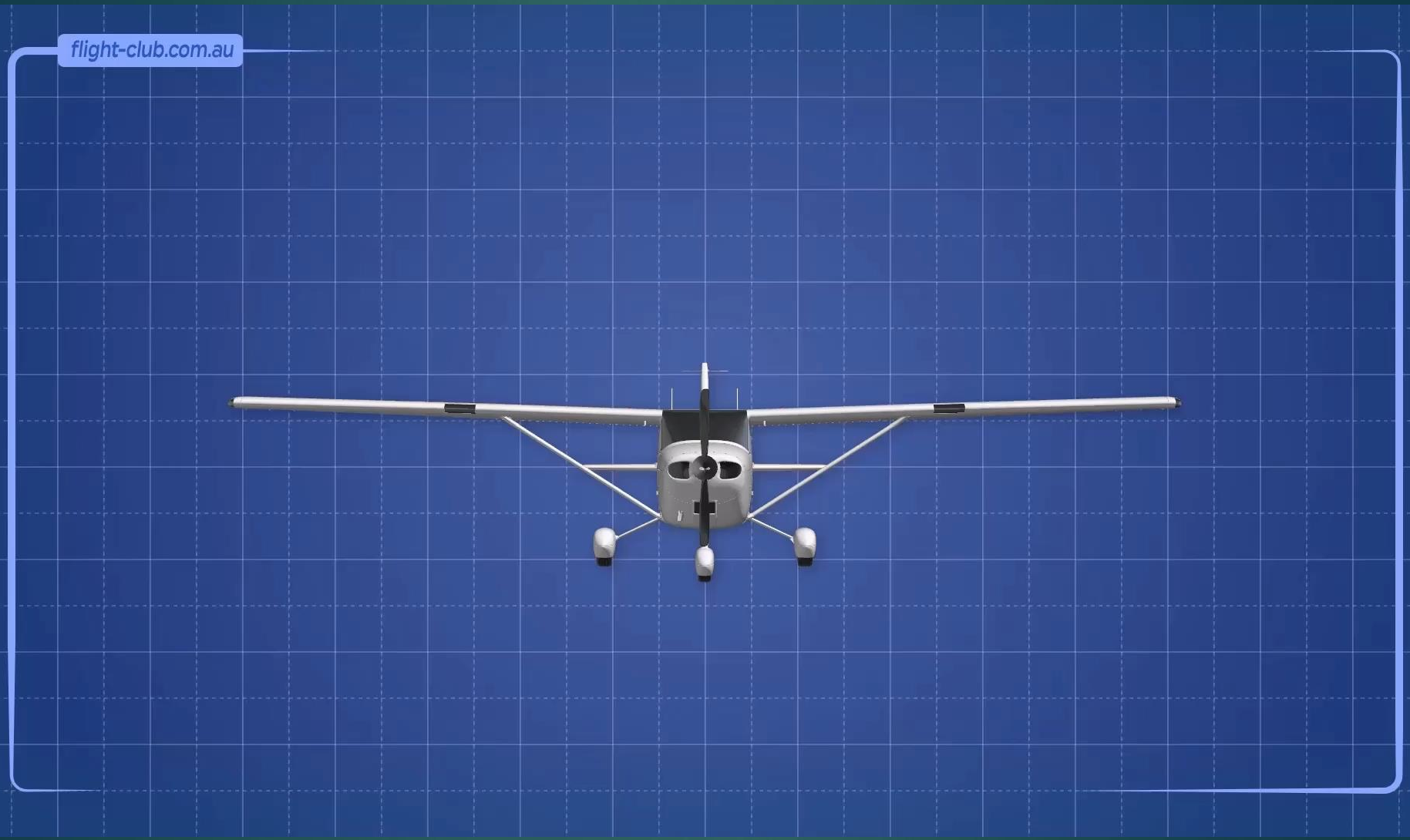
Even though 24 volts can provide 20 amps of current (water), the electrical equipment here draws only 5 amps of current (water).



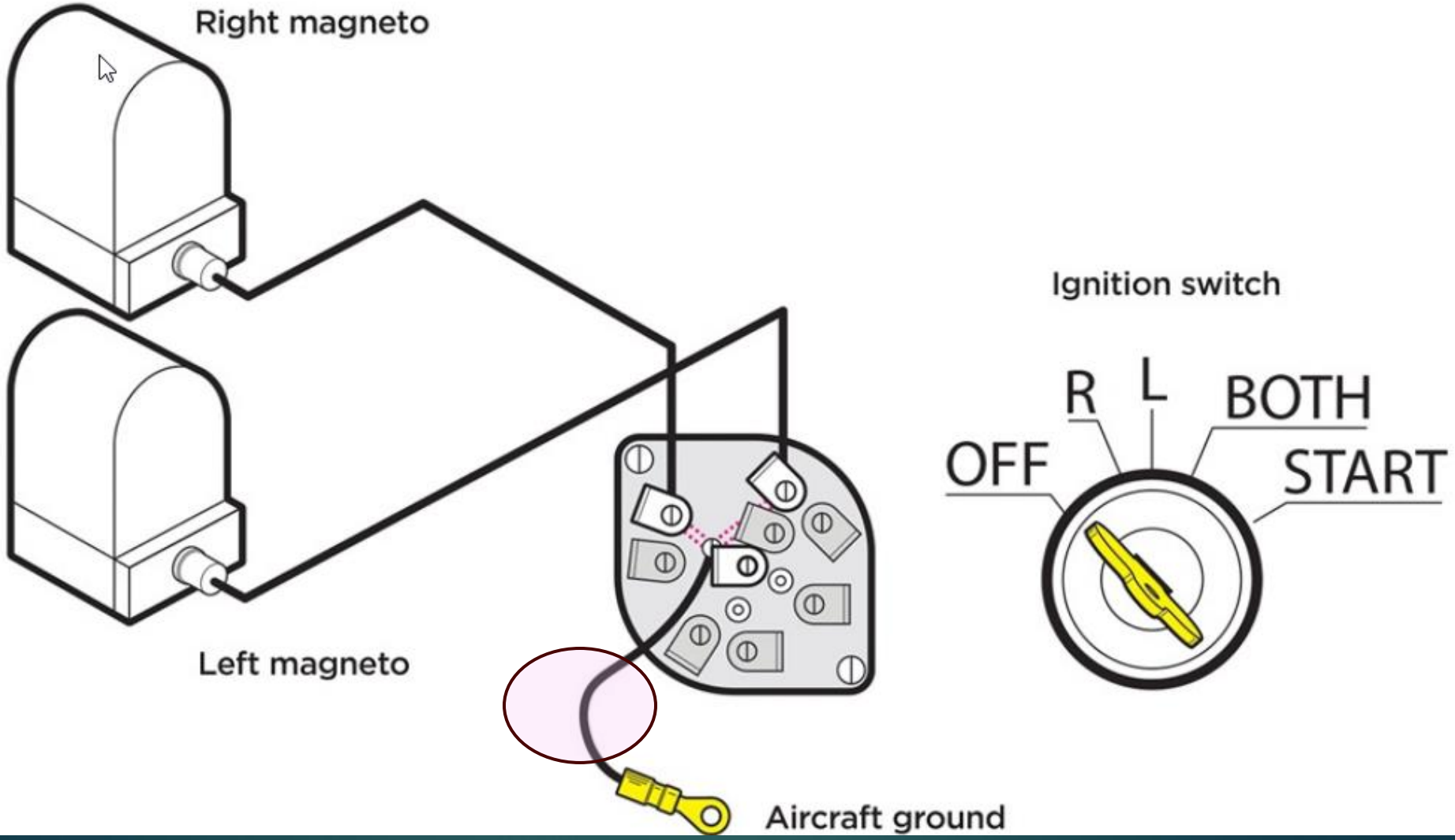
Starting the engine: Magnetos



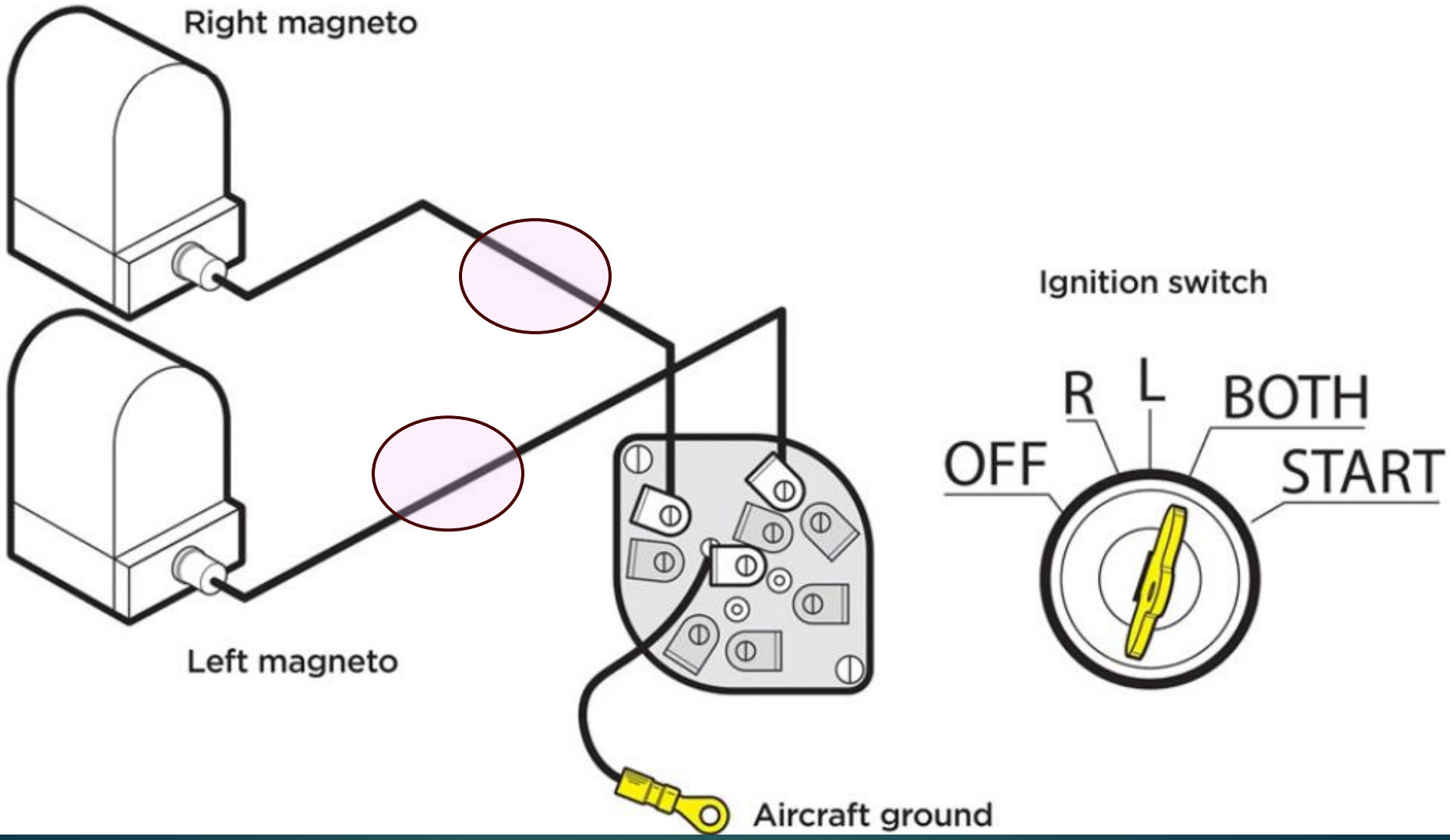
How magnetos work



P-Leads and Grounding



P-Leads and Grounding

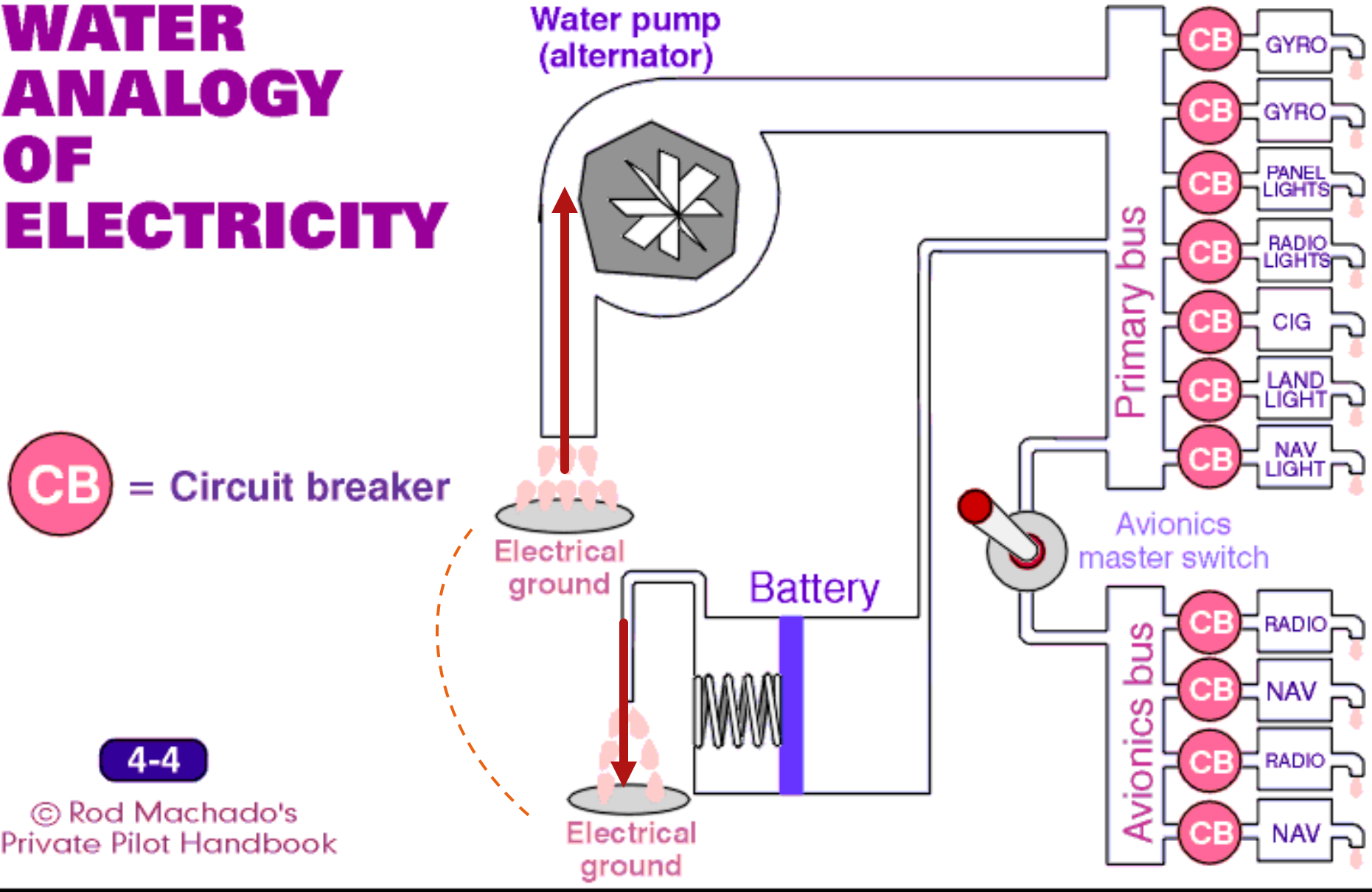


Replenishing the battery: generators and alternators

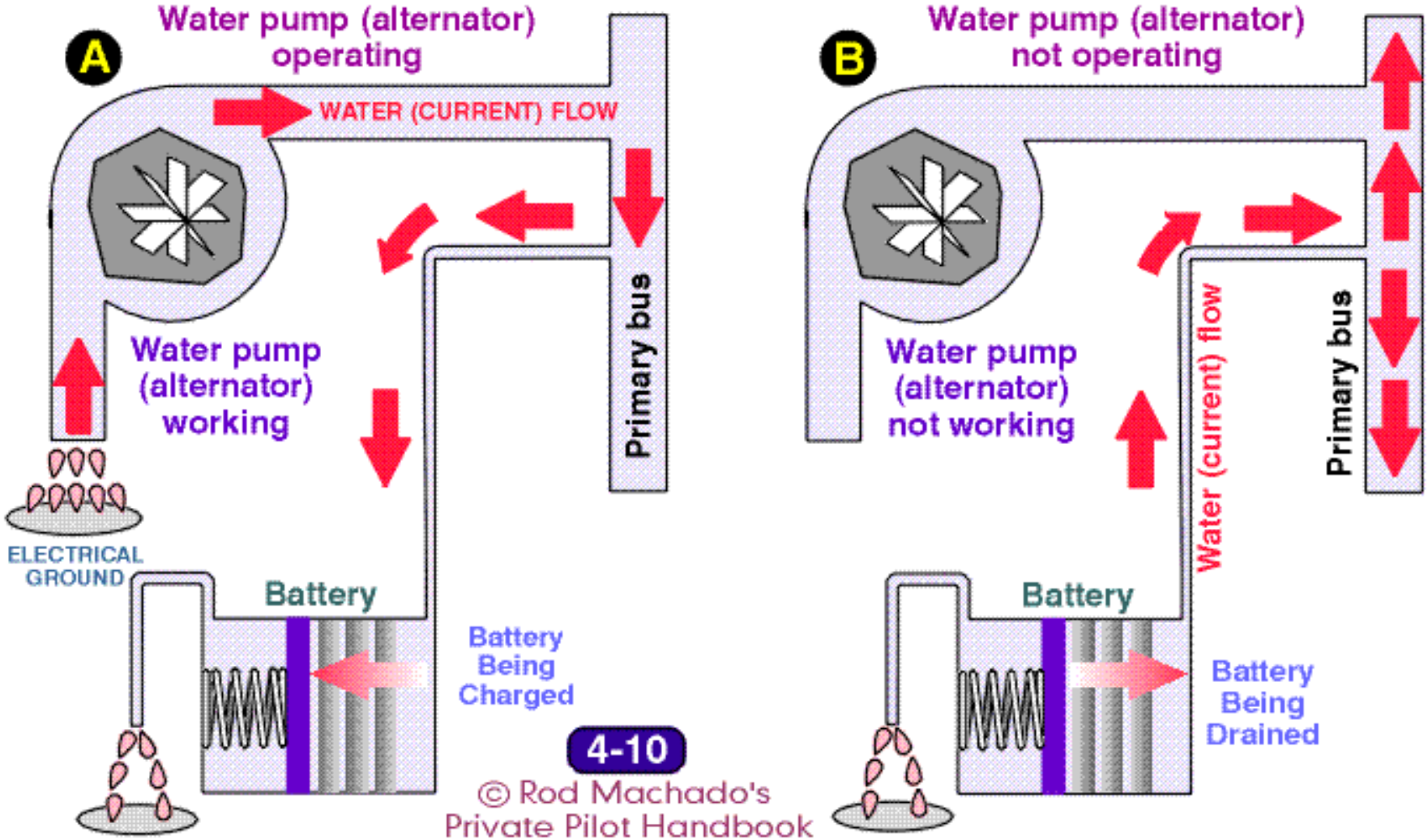
Alternators vs. Generators

- An alternator is a device that converts mechanical energy into alternating current electrical energy.
- A generator is a mechanical device that converts mechanical energy to either alternating or direct current electrical energy.
- Therefore: all generators are alternators, but not all alternators are generators.
- From a pilot's point of view, think of them as the same thing: an engine-driven accessory which converts rotational energy from the crankshaft into electricity to both power electrical components in the airplane and to recharge the battery.

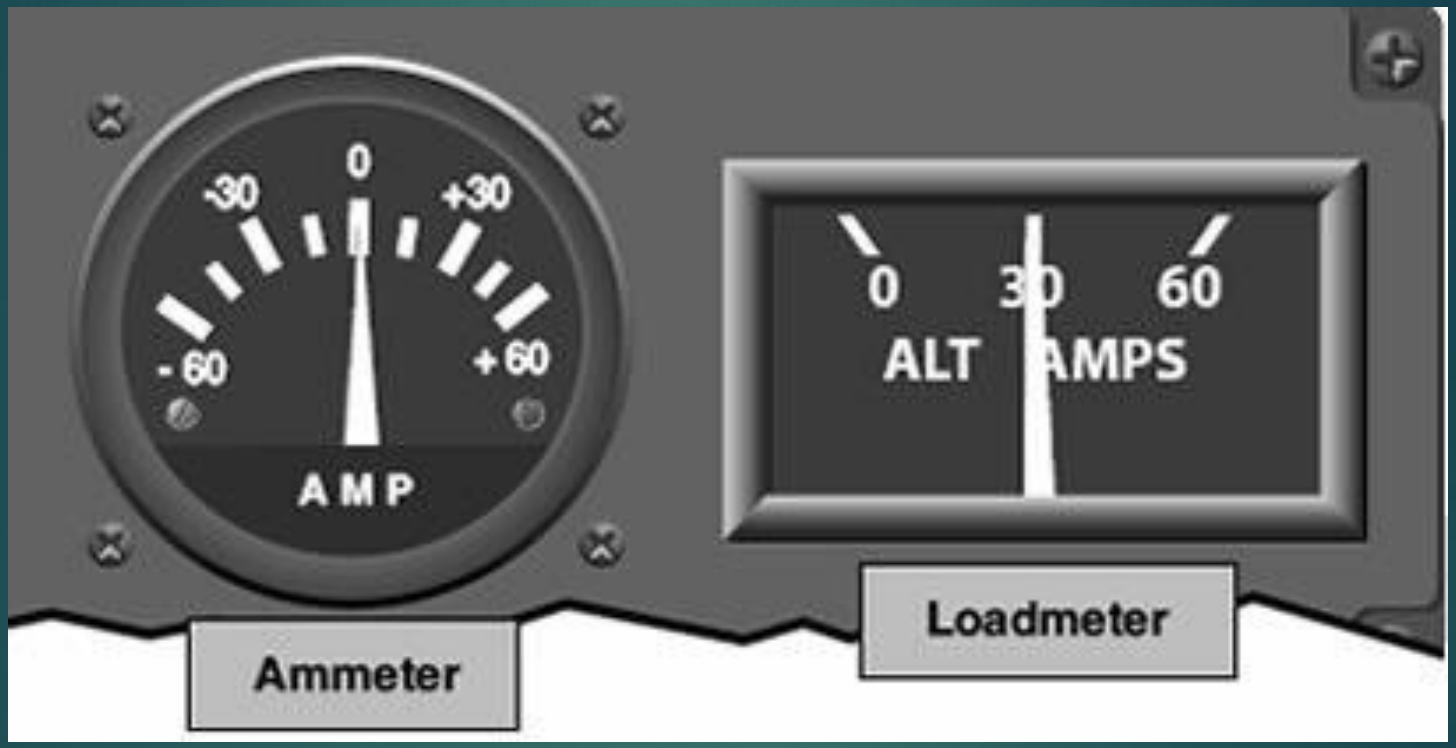
WATER ANALOGY OF ELECTRICITY



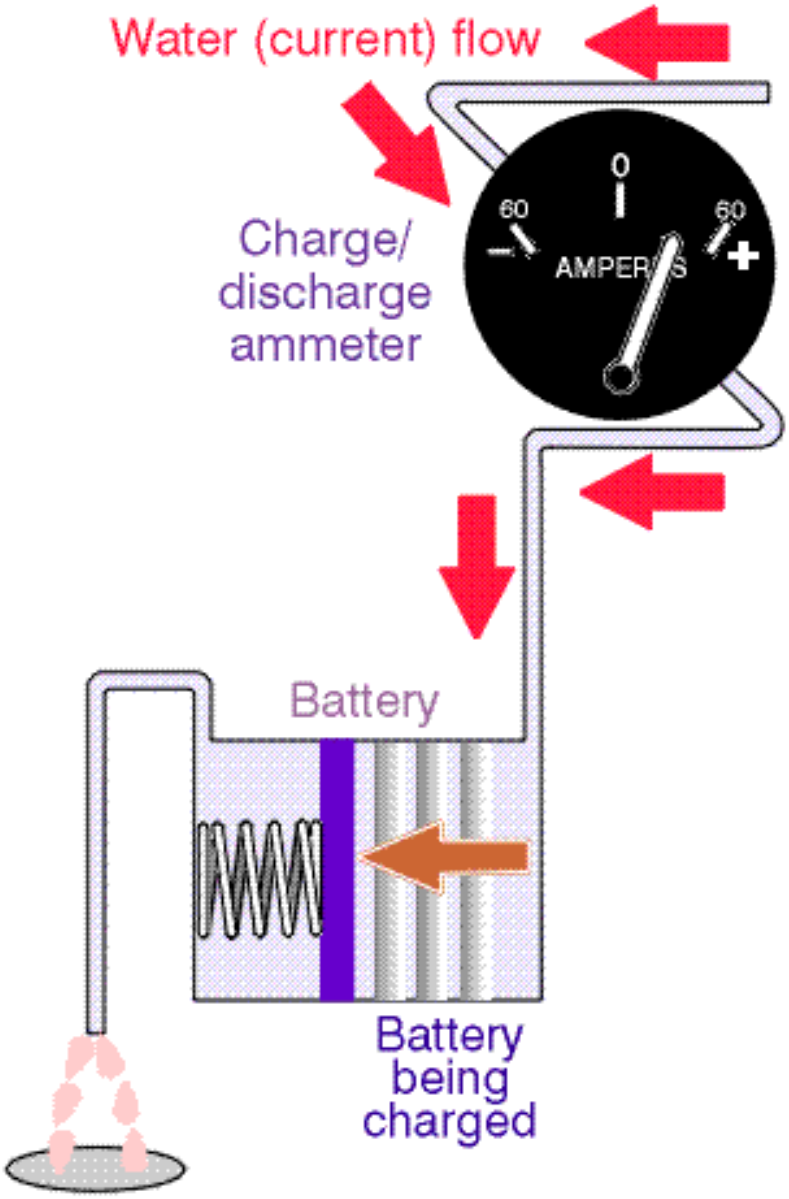
WATER PUMP (ALTERNATOR) & BATTERY PRESSURIZING THE PRIMARY BUS



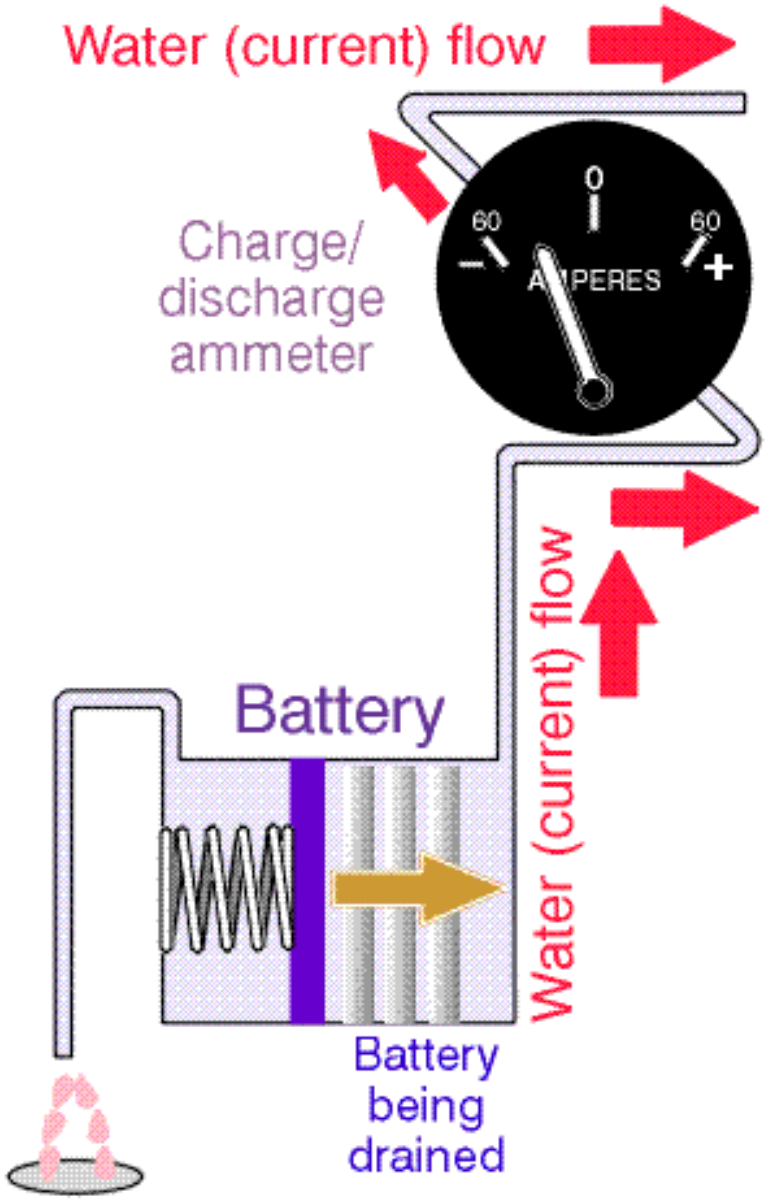
Ammeter vs Loadmeter



POSITIVE (+) AMMETER INDICATION



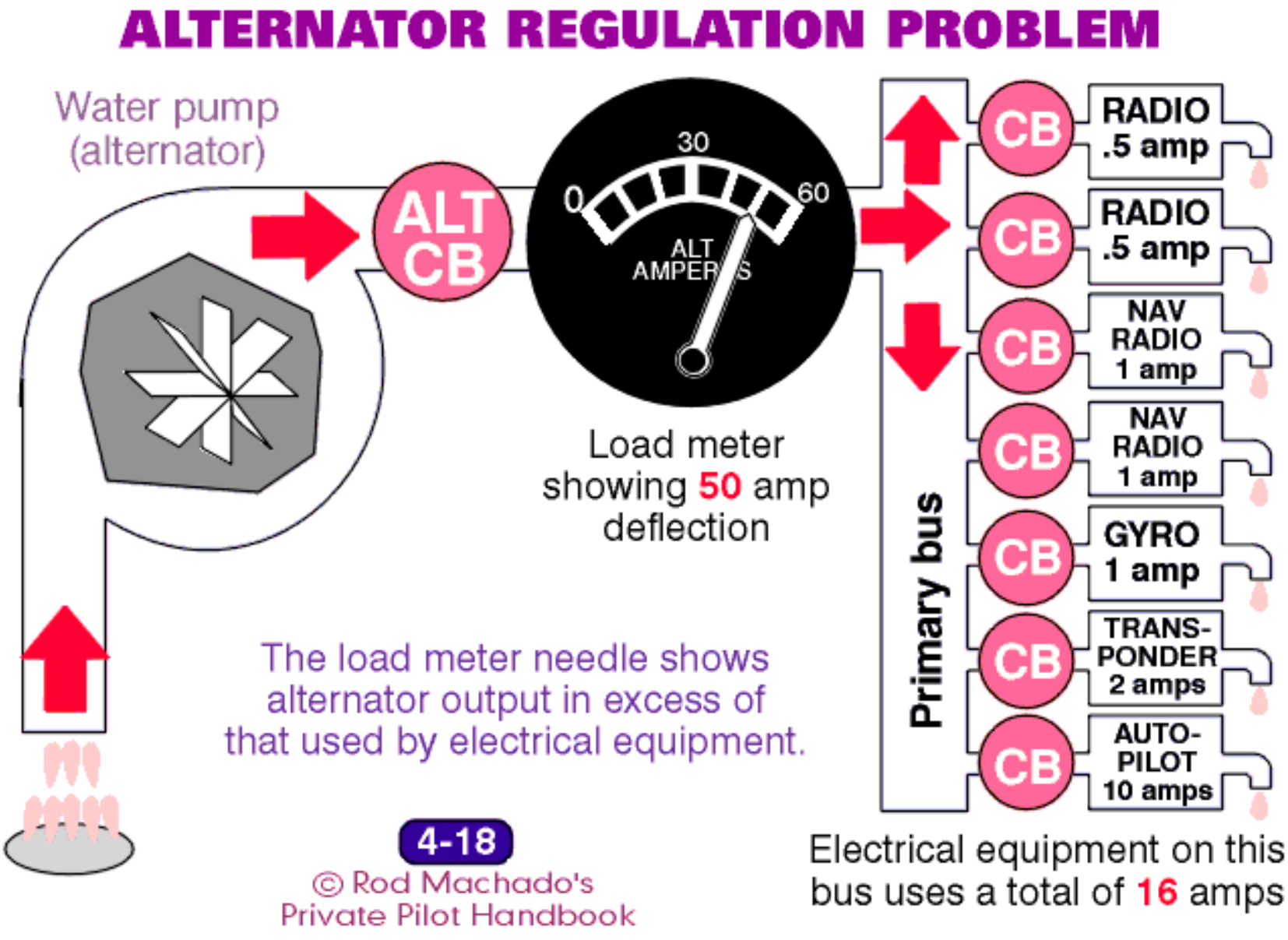
NEGATIVE (-) AMMETER INDICATION



Voltage Regulation

- Unregulated, the flow back to the battery after electricity is siphoned to run the electrical components in the panel could potentially "cook" the battery resulting in permanent damage and electrical system failure
- Alternators/generators incorporate a component called a "voltage regulator" to ensure that no more energy is delivered back to the battery than can be stored
- If the voltage regulator fails, the alternator/generator must be shut down to prevent damage to the battery and potential electrical fires

Faulty Voltage Regulator



Emergency Electrical Procedures

ELECTRICAL FIRE

An electrical fire is usually indicated by an odor of hot or burning insulation.

- Electrical Switches – ALL OFF (leave Ignition Switches – ON)
- 30A "Gen Main Bus" Fuse – PULL – REMOVE
- Air Vent – OPEN if necessary for smoke removal and ventilation
- Use hand fire extinguisher if available
- Land immediately (or as soon as practical if location for safe landing is not available)

LOW VOLTAGE/DISCHARGE

A generator failure is indicated by a steady discharge on the ammeter and voltage indication less than 12.0 volts.

- Non-Essential Electrical Equipment - OFF
- Avionics Switch – OFF (the EFIS and GPS will continue to operate on the EFIS backup battery)
- Land as soon as possible as the battery and EFIS backup battery will furnish electrical power for a limited time only.

HIGH VOLTAGE

A voltage in excess of 15 volts indicates a runaway generator.

- Master - OFF
- 30A Main Bus Fuse – PULL-REMOVE immediately
- Non-Essential Electrical Equipment - OFF
- Avionics Switch – OFF (the EFIS and GPS will continue to operate on the EFIS backup battery)
- Land as soon as possible as the battery will furnish electrical power for a limited time only.

Next time:

- Aeronautical Decision-Making
  - PHAK Chapter 2
  - Machado Chapter 17
- Aeromedical Factors
  - PHAK Chapter 17
  - Machado Chapter 17
- Quiz:
  - Engines
  - Electrical