Tiger Cub ‘65 Electrical System

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Electrical System Components

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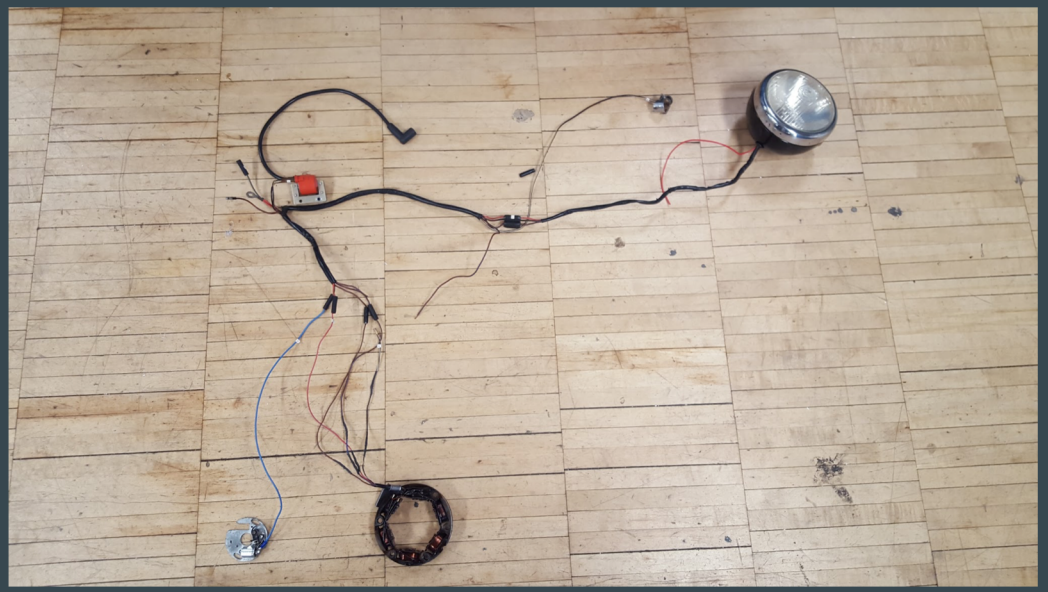
The electrical system is a series of electrical components throughout the bike that perform many different functions

- Alternator
  - Rotor
  - Stator
- Distributor
- Contact Points
- Ignition Coil
- Spark Plug



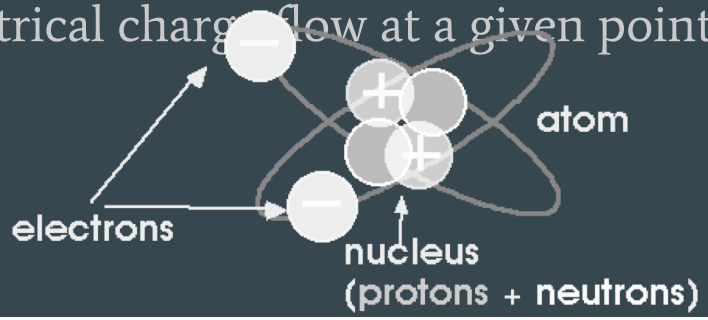
Physics 101: Electrical Systems

Charge: a physical property of matter, described as either a positive or negative value, that explains the behaviour of said matter, expressed in units of coulombs (C) .

Example: positively charged materials repel each other

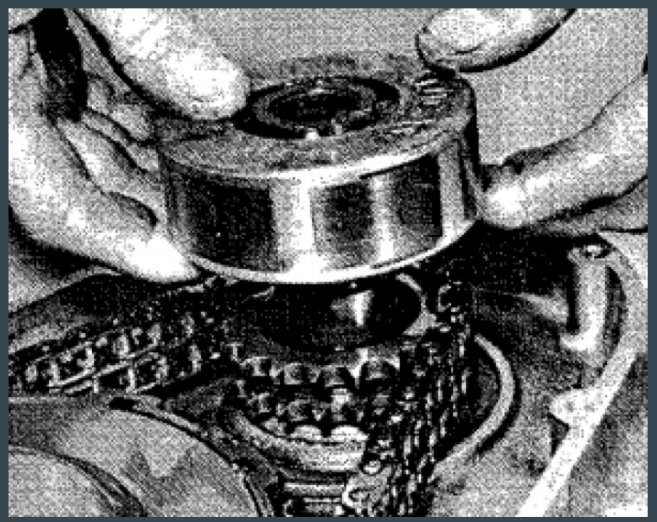
Voltage: the electromotive force or potential difference across two points, expressed in units of volts (V).

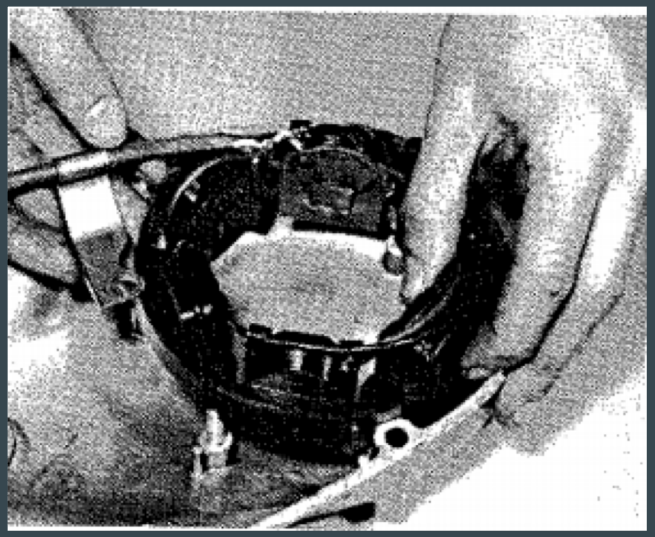
Current: the rate of electrical charge flow at a given point in a circuit, expressed in units of amperes (A).



The Alternator

- converts kinetic energy (motion of crankshaft) into electrical energy (AC - alternating current)
- placed over the crankshaft in the engine
- consists of the stator and the rotor



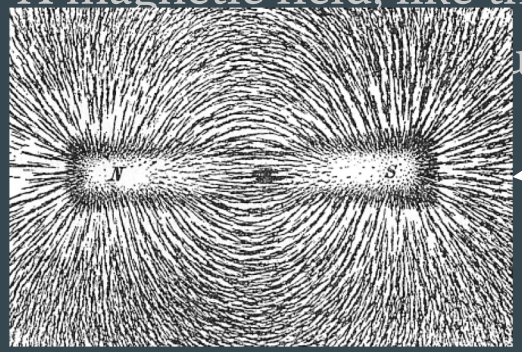


Physics 101: Magnetic Field

Magnetic Field: a region of space near a magnet, electric current, or moving charged particle in which a magnetic force acts on any other magnet, electric current, or moving charged particle. (Random House Dictionary)

The Tiger Cub uses the magnetic field created by a large magnet called a rotor (to be discussed later) to power the bike systems.

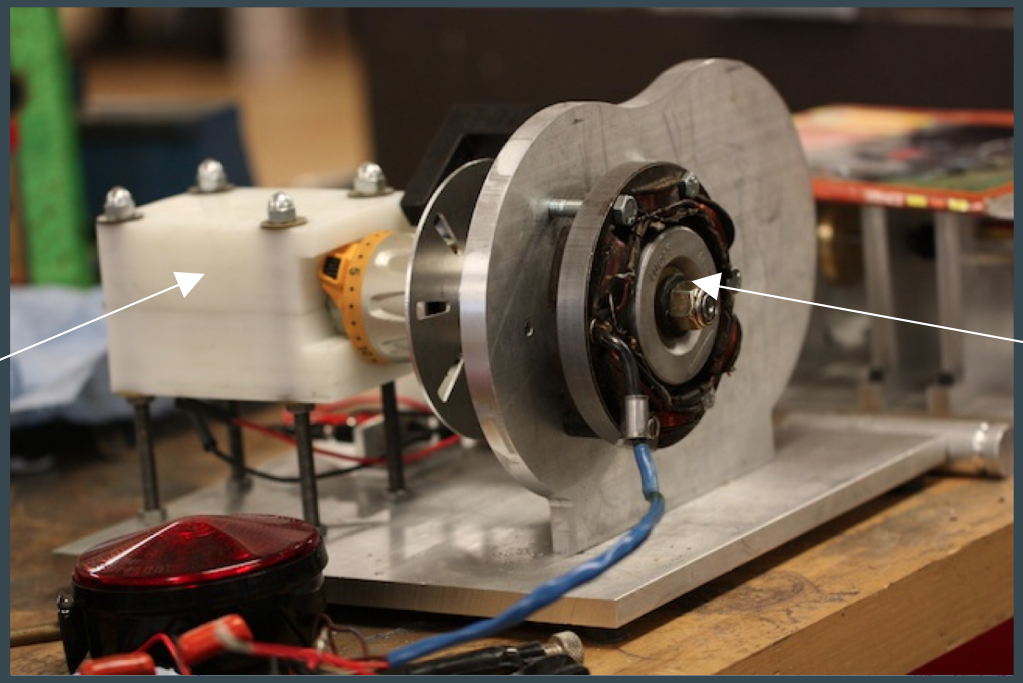
A magnetic field, like the one that the rotor produces, can be used to create an ugh a process known as magnetic induction.



The magnetic field of a typical bar magnet.

The Rotor

- Contains 3 permanent magnets and spins within the stator to produce electrical energy
- Connected to the engine, the rotor is driven by the crankshaft



The Stator

- Has between four to eighteen spokes or poles arranged in a circle
- Each spoke has copper magnet wire wound around it
- As the rotor spins and passes by each spoke, different levels of voltage are produced due to the varying number of coils around each spoke
- These different voltage levels power different parts of the motorcycle (high voltage output is for powering the spark plug, for example, whereas low voltage output is for the brake light)
- Produces Alternating Current

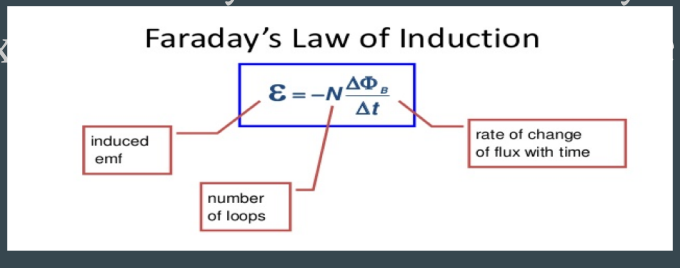
Physics 101: Magnetic Induction

Magnetic Flux: the amount of magnetic field "lines" that cross through a region. Areas that experience a more powerful magnetic field are said to have a higher "magnetic flux density" a.k.a. Magnetic Induction.

$$\phi_m = NBA\cos(\theta)$$

The Tiger Cub has a circular set of wire coils called the stator, which sits around the rotor to create electric current.

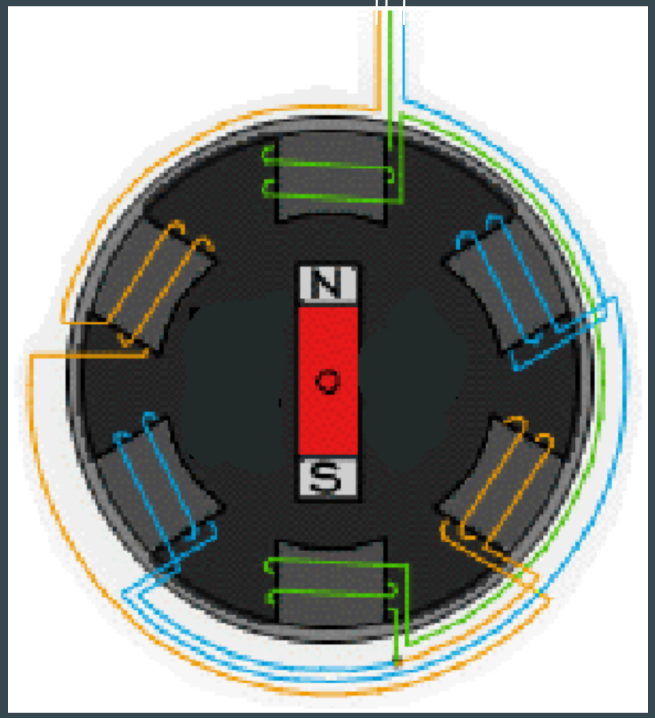
The stator is able to create electricity thanks to Faraday's Law, which states that a changing magnetic flux [illegible] force (emf) which in turn causes current to flow



The Alternator in Action

Current supplied to various bike components

On the 65', four wires leave the stator. One is an electrical ground which is connected to the bike frame via the wiring harness, and the others power various other parts of the bike



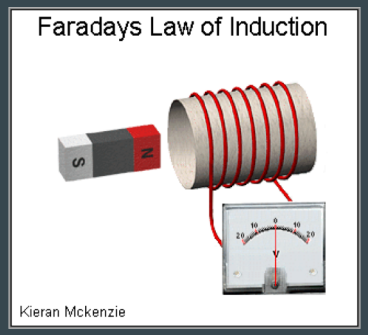
Electric current is only generated when the magnetic flux in a stator spoke is changing. This means that electric current is only generated when a magnetic pole of the rotor is moving towards or away from a spoke. The current generated by the towards motion is opposite in direction as that of the away motion.

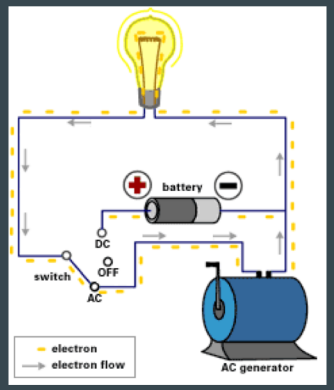
Physics 101: AC Current

As shown at the right, a changing magnetic field can induce a current in a coil of wire.

The 65' creates electricity in a similar way, except the magnet does not move into the coil of wire, but rather spins past it, creating a current.

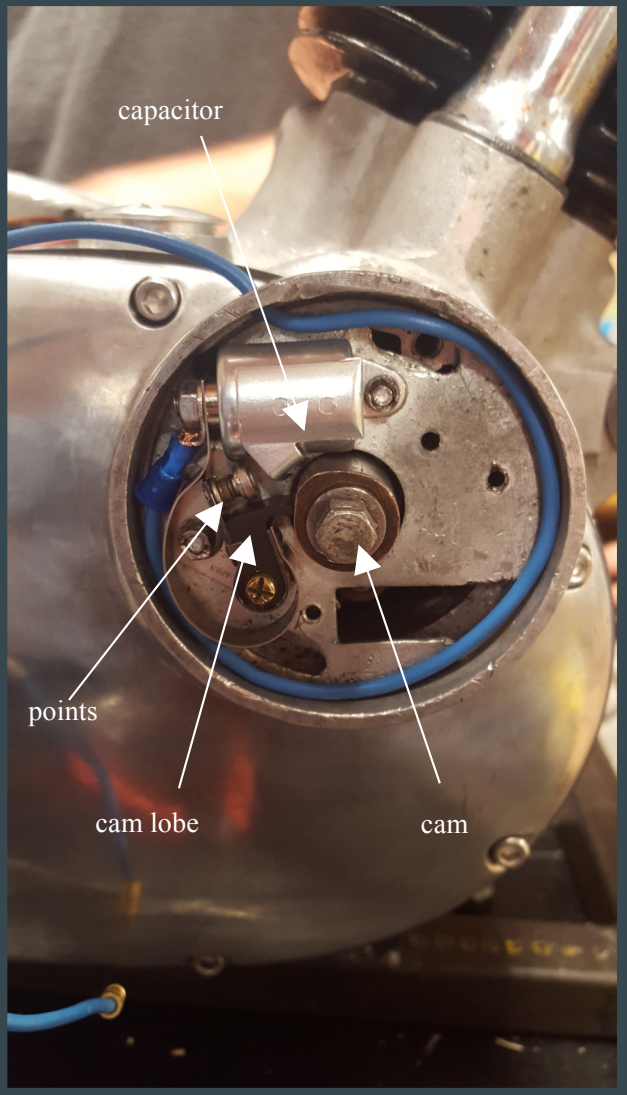
Alternating Current: flow of charge in an electrical system that periodically reverses direction.





The Distributor

- A device in the ignition system that routes high voltage from the ignition coil to the spark plugs at the correct time
- An engine gear drives the distributor shaft, which in turn spins the cam that pushes the cam lobe, and the cam lobe opens the contact points
- Also contains a capacitor (or condenser), which collects charge and prevents it from arcing across the points.
- It is important to adjust the points from time to time, because with wear the engine requires sparks at different rates



The Contact Points

- A switching device found in the distributor of the ignition systems, works with a rotating cam on the end of the crankshaft
- Interrupts the current flowing in the primary circuit of the ignition coil
- The collapsing current induces a high voltage in the secondary winding of the coil, causing a very high voltage to appear at the coil output for a short period—enough to arc across the electrodes of a spark plug
- The position of the contact breaker is set so that they open at the exactly correct moment needed to ignite the fuel at the top of the piston's compression stroke

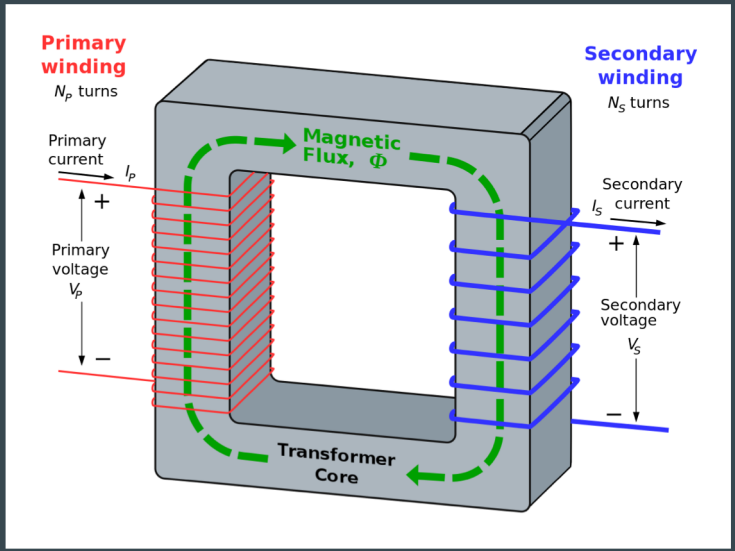
Physics 101: Transformers

Transformer: a device that utilizes the ferromagnetic properties of an iron (or other metal) core to raise or lower AC voltages.

The ignition coil on a bike, is a transformer which takes the relatively low voltage of the alternator and “steps it up” for the spark plug.

There is a “primary” input side and a “secondary” output side by convention, though it can be used in either direction.

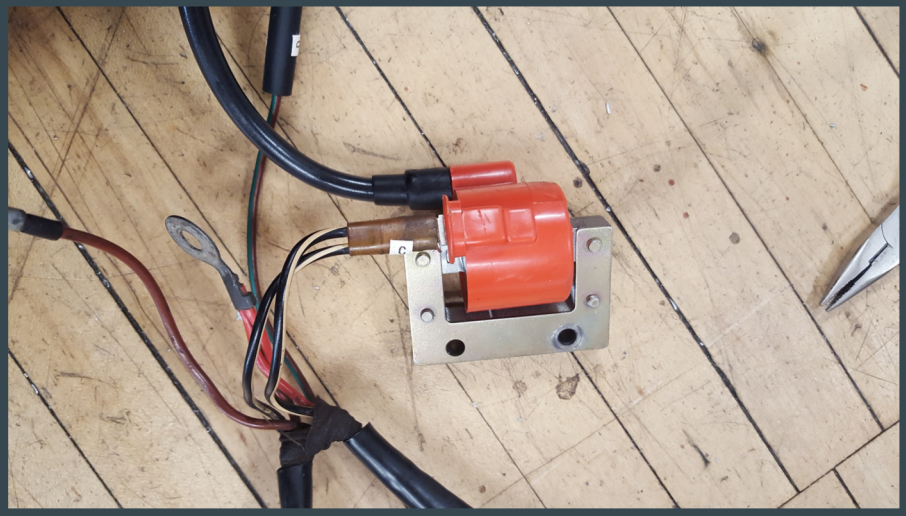
The voltage and current across a transformer are inversely proportional, so a higher voltage will be accompanied by a very low current and vice-versa.

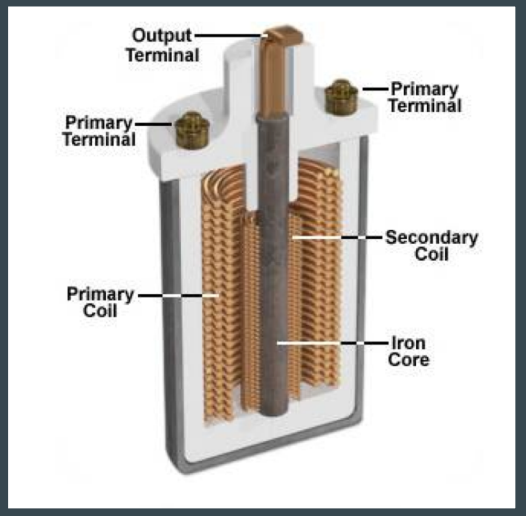


$$\frac{V_\mathrm{s}}{V_\mathrm{p}} = \frac{N_\mathrm{s}}{N_\mathrm{p}} = \frac{I_\mathrm{p}}{I_\mathrm{s}}.$$

The Ignition Coil

- An induction coil which transforms the alternator's low voltage to the thousands of volts needed to create an electric spark in the spark plugs
- consists of a laminated iron core surrounded by two coils of copper wire
- the energy that is stored in the magnetic field of the core is the energy that is transferred to the spark plug
- typically has a 1:100 turns ratio, meaning that the secondary coil has 100 times more turns than the primary coil, so whatever voltage that enters the primary coil is multiplied by 100 times in the secondary coil





The Spark Plug

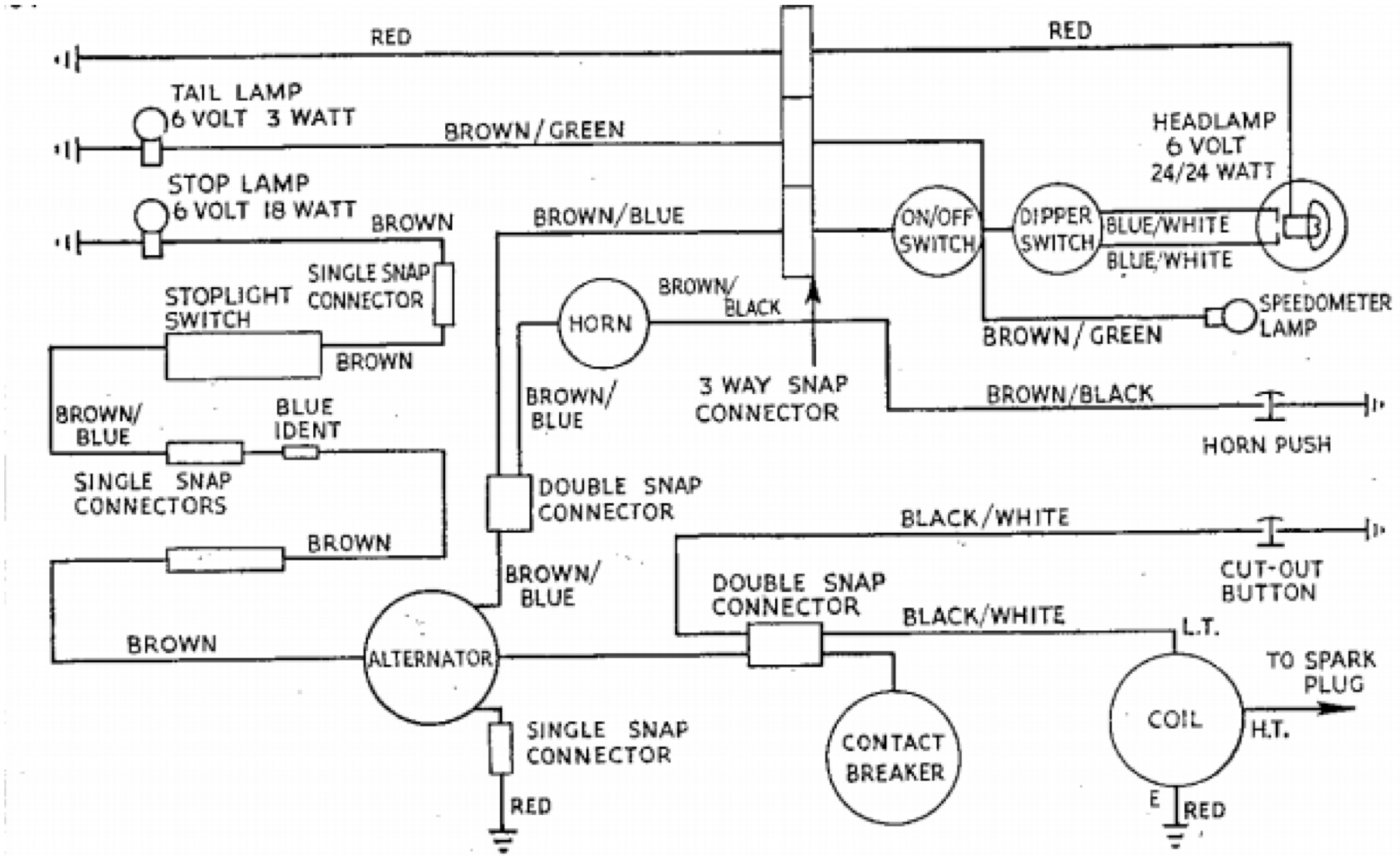
- a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel-air mixture by an electric spark
- electricity must be at a very high voltage in order to travel across the gap and create a good spark
- voltage at the spark plug can be anywhere from 10,000 to 50,000 volts

spark gap

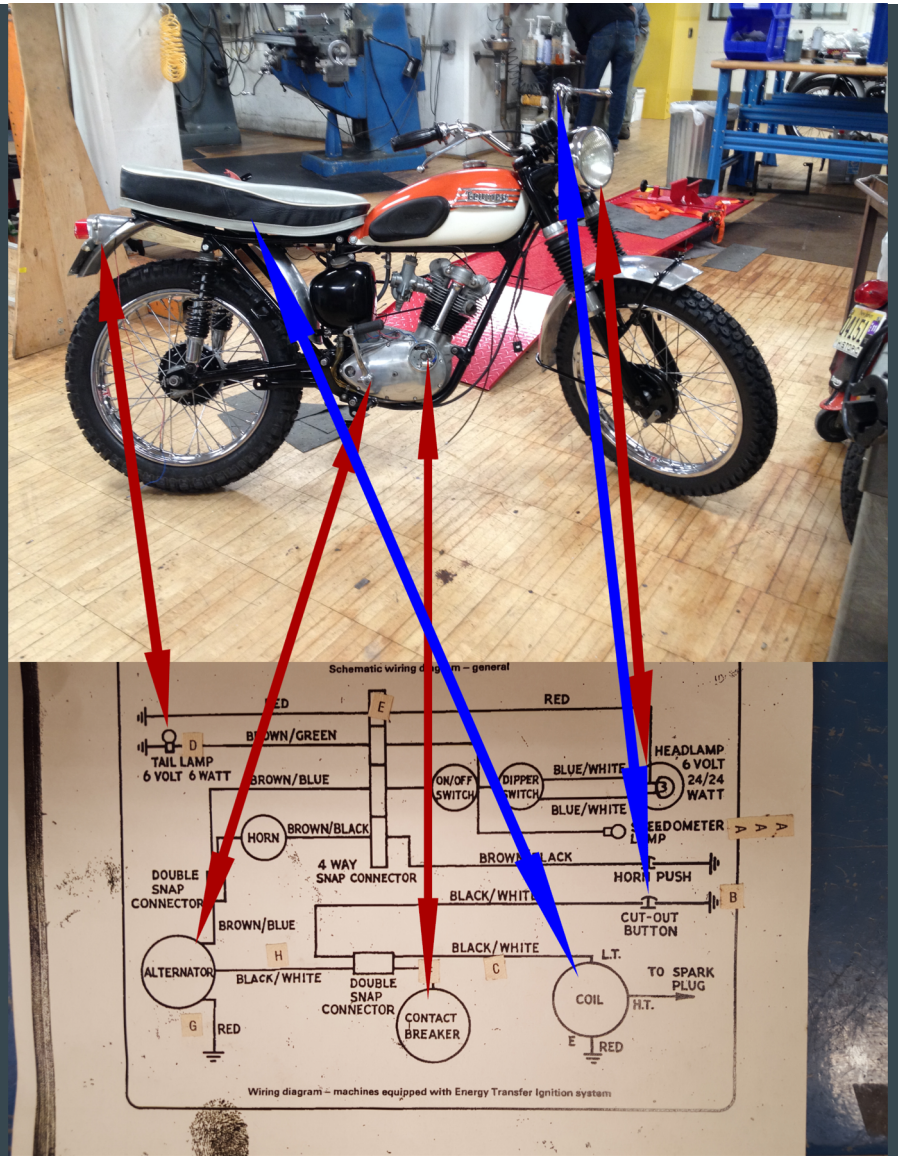
Headlamp

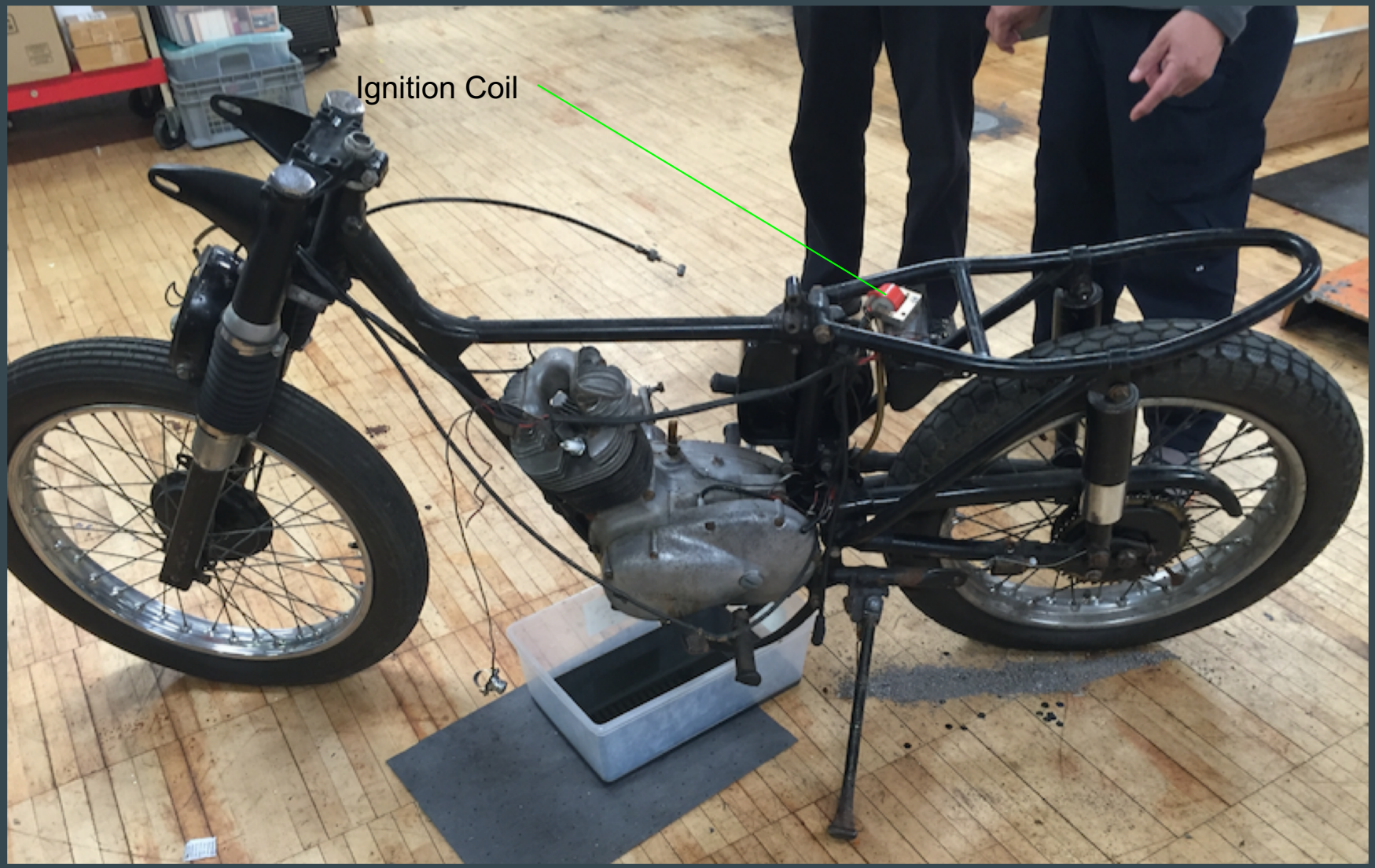
- Required the most time to repair, due to the complexity of the internal electronics
- Needed a new bulb and fixture as the old assembly (shown at right) was falling apart
- Hub of several electrical wires, including the speedometer lamp and high beam indicator


connects to spark plug
ignition coil
headlight
cut-off button
distributor
alternator
Wiring Harness


RED
RED
TAIL LAMP
6 VOLT 3 WATT
BROWN/GREEN
HEADLAMP
6 VOLT
24/24 WATT
STOP LAMP
6 VOLT 18 WATT
BROWN
BROWN/BLUE
ON/OFF SWITCH
DIPPER SWITCH
BLUE/WHITE
BLUE/WHITE
SINGLE SNAP CONNECTOR
STOPLIGHT SWITCH
BROWN
HORN
BROWN/ BLACK
SPEEDOMETER LAMP
BROWN/ GREEN
BROWN/ BLUE
BLUE IDENT
3 WAY SNAP CONNECTOR
BROWN/BLACK
HORN PUSH
SINGLE SNAP CONNECTORS
DOUBLE SNAP CONNECTOR
BLACK/WHITE
CUT-OUT BUTTON
BROWN
BROWN/ BLUE
DOUBLE SNAP CONNECTOR
BLACK/WHITE
L.T.
BROWN
ALTERNATOR
TO SPARK PLUG
COIL
H.T.
SINGLE SNAP CONNECTOR
CONTACT BREAKER
E
RED
RED

Location of Electrical Components

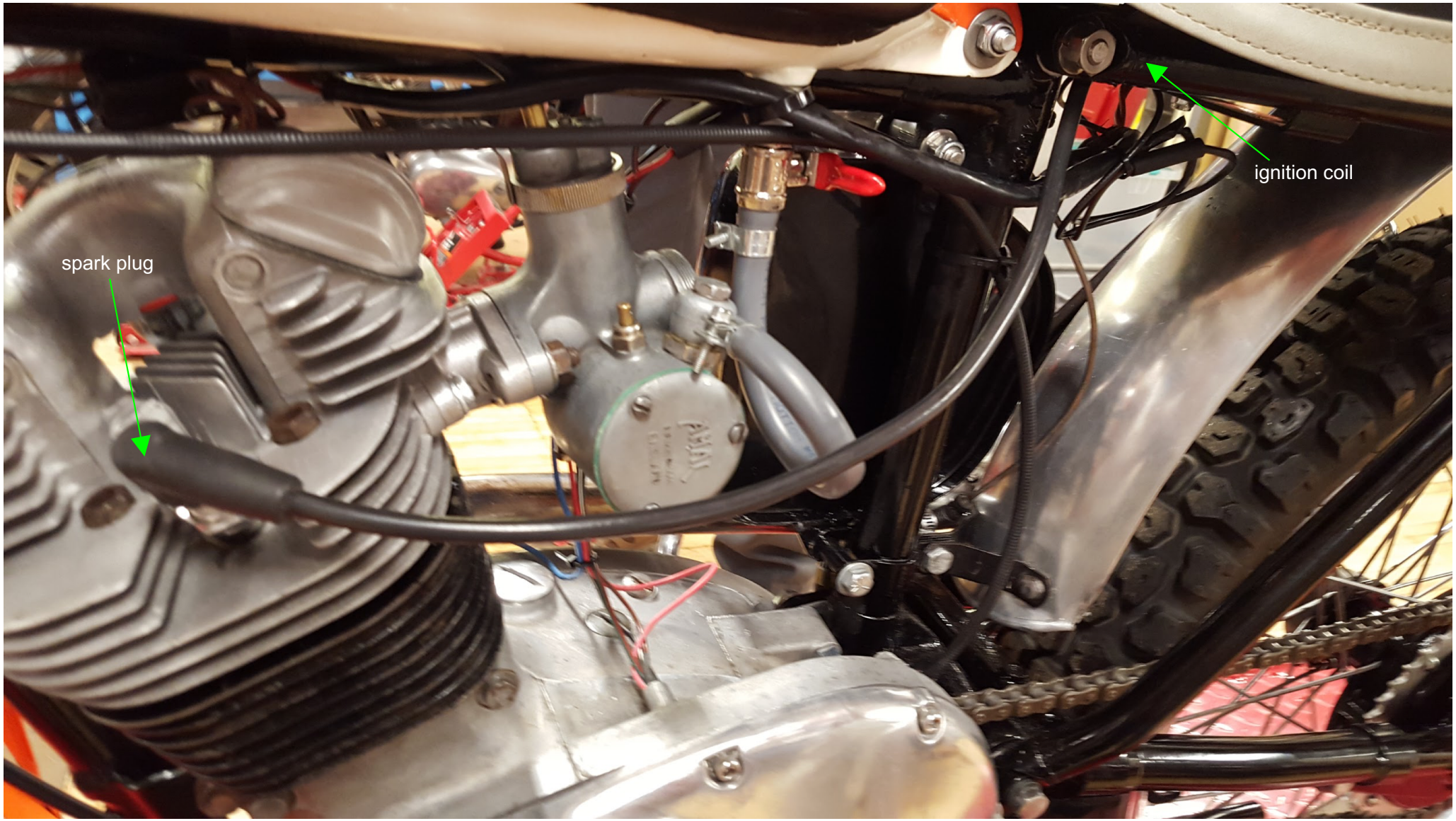

Schematic wiring diagram – general
RED
BROWN/GREEN
TAIL LAMP
6 VOLT 6 WATT
BROWN/BLUE
ON/OFF SWITCH
DIPPER SWITCH
BLUE/WHITE
HEADLAMP
6 VOLT
24/24
WATT
BLUE/WHITE
SPEEDOMETER LAMP
HORN
BROWN/BLACK
4 WAY
SNAP CONNECTOR
BROWN/BLACK
HORN PUSH
DOUBLE
SNAP
CONNECTOR
BLACK/WHITE
CUT-OUT
BUTTON
BROWN/BLUE
BLACK/WHITE
L.T.
ALTERNATOR
BLACK/WHITE
DOUBLE
SNAP
CONNECTOR
CONTACT
BREAKER
COIL
TO SPARK
PLUG
H.T.
RED
RED
Wiring diagram – machines equipped with Energy Transfer Ignition system

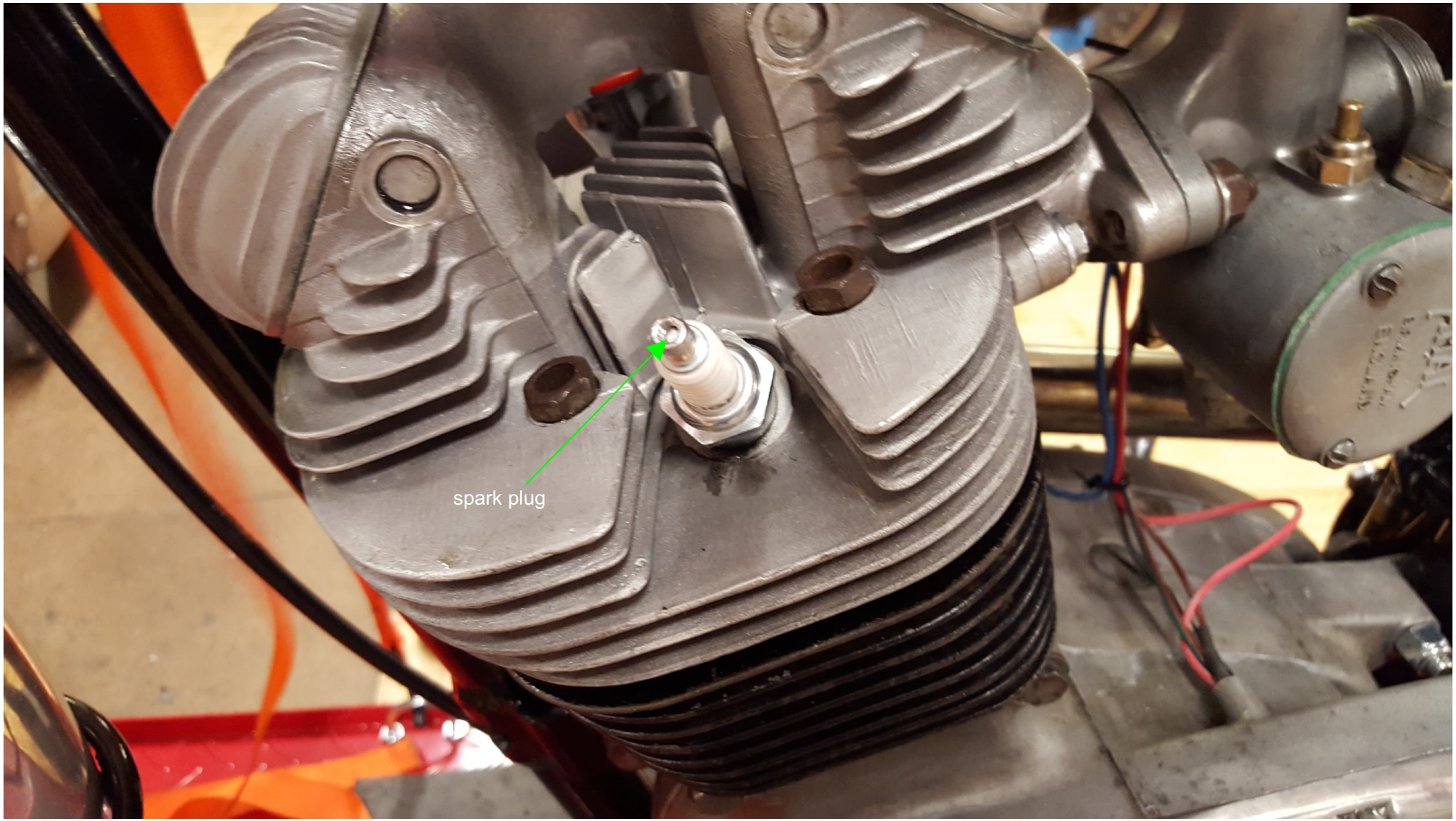

Ignition Coil

Alternator

Contact Breaker (The Points)


Kill Switch
Headlamp


ignition coil
spark plug


spark plug

Chronology of Electrical Components

(1)The engine crankshaft spins the alternator’s rotor (magnets)
(2)As the rotor (magnets) spins and passes by the stator’s spokes of coiled copper wire, voltage is produced (via magnetic induction)
(3)Meanwhile in the distributor, an engine gear drives the distributor shaft, which in turn spins the cam that pushes the hammer-like piece back, and this hammer-like piece opens the contact points
(4)Opening the points causes a high induction voltage in the system's ignition coil, which transforms the alternator’s low voltage to the thousands of volts needed to create an electric spark in the spark plugs
(5)The spark plugs deliver electric current from an ignition system to the combustion chamber to ignite the compressed fuel/air mixture by an electric spark
(6)The gasoline explosions in the engine move pistons, which in turn run the crankshaft
(7)The crankshaft spins the rotor

Technical Skill

Soldering

- A process by which two or more items (usually metal) are joined together by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal
- For our purposes, those two pieces of metal are copper wire
- Rosin core solder is best for soldering electrical connections

Soldering instructions:

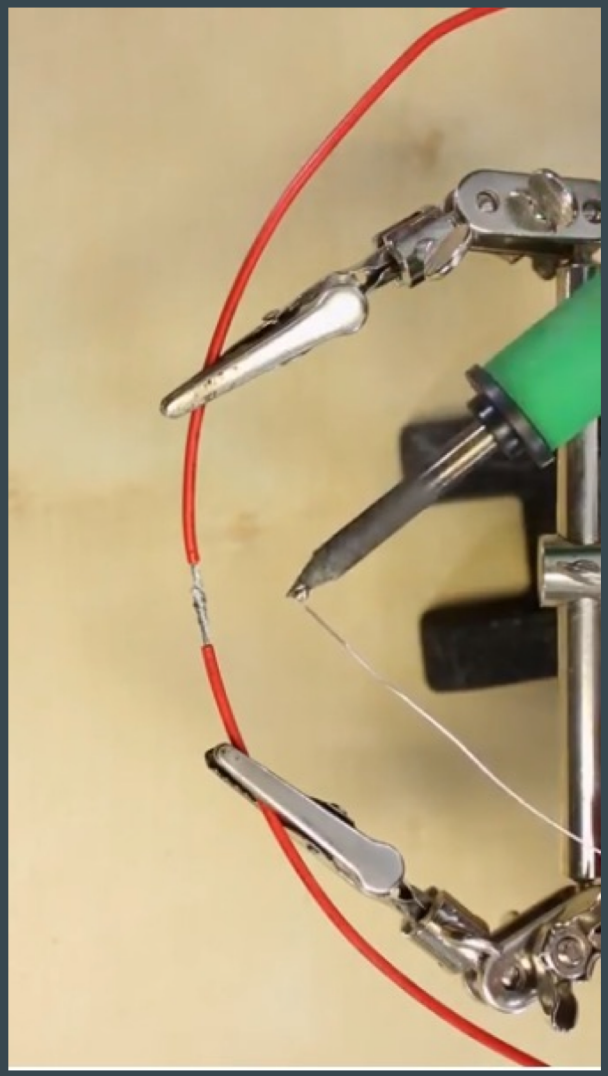
(1) Strip the wire of all insulation back as far (usually about 3/4"-1") as you need from the end to be soldered; do this to both wires to be soldered

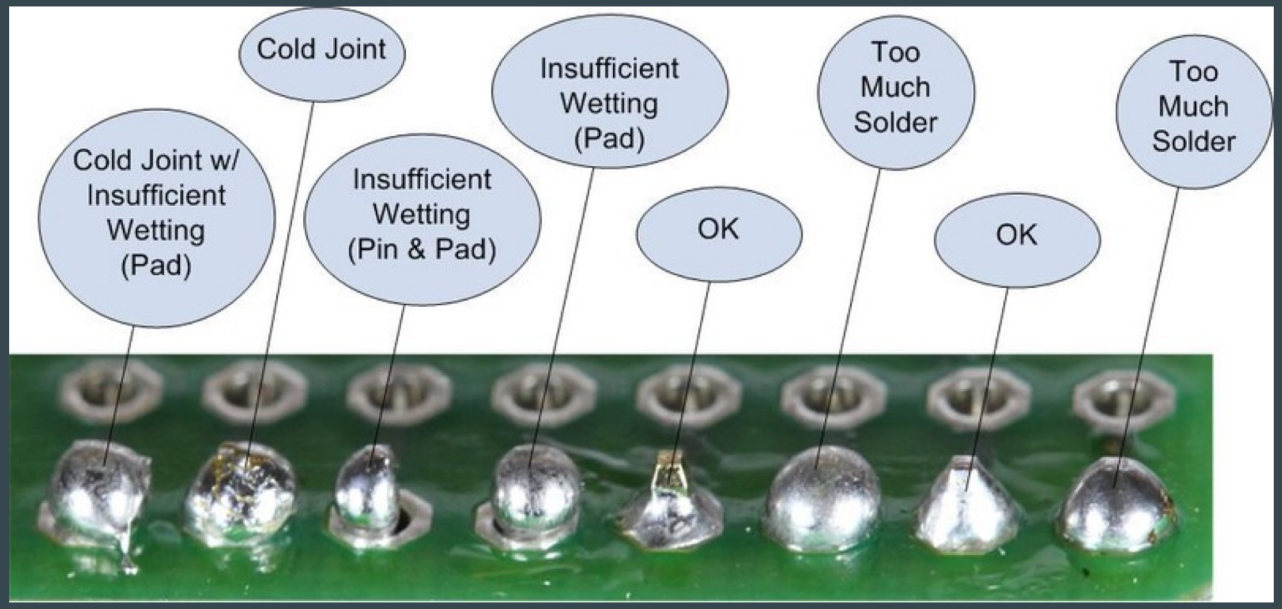
(1) If you are going to use heat shrink tubing for insulation, put a length of it on the wire now

(1) Twist the wires together

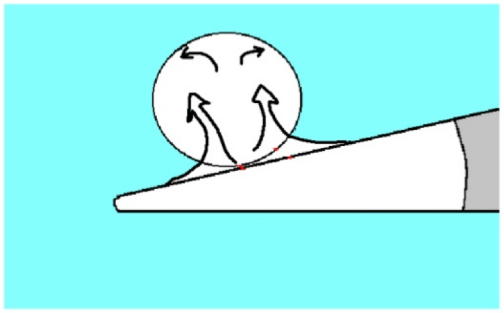
(2) Apply heat to the twisted tire with a soldering iron

(3) Touch the twisted wire with the solder as you heat it up; the solder will melt and flow into and between the twisted wire; when the solder looks good (nice and smooth, not balled up or with gaps in it), you're done!

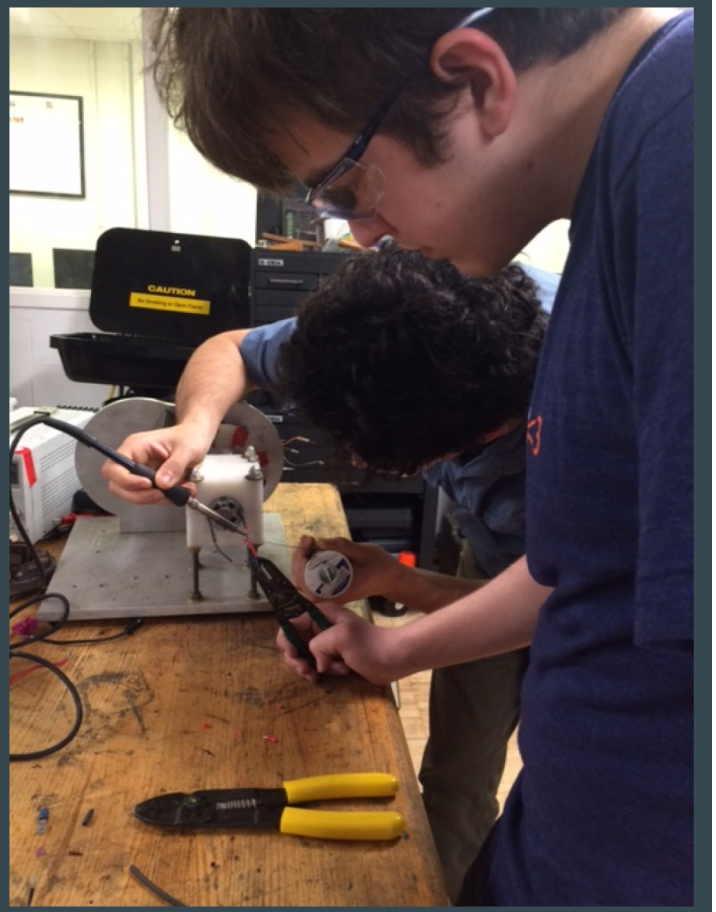




Capillary Action



Wicking action draws solder into wire strands



Electrical Safety

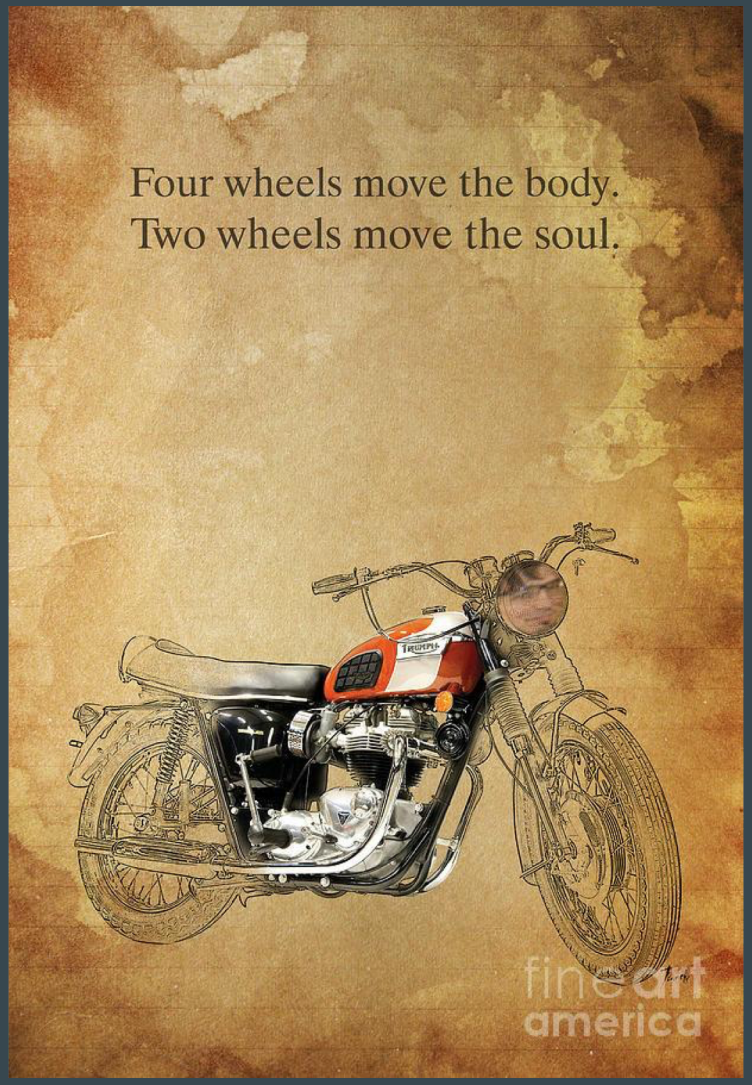
It is a common misconception that high voltage systems are the only ones that kill. Actually, it is mostly the electrical current that causes bodily harm

Never work on an electrical system while it is “under power”. If your skin is moist and you are at a lower electric potential than the system you may receive shocks or electrical burns from the system.

If an electrical system has enough current running through it, coming into contact with it can result in electrocution (death). A current as low as 0.1 Amp can be fatal (note that U.S. outlets are normally rated at 15 Amps).

Electric shocks can interfere with the function of the heart or the brain and even low-amp shocks can have long-term health effects.

The End


Four wheels move the body.
Two wheels move the soul.
fineart
america