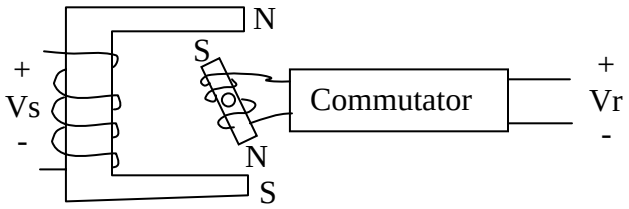
DC Machines -- Lab Review Sheet

Principles of a DC Machine:

A DC machines consists of two electromagnets excited by DC sources. Torque and rotation are generated through the interaction of the magnetic fields and the switching of polarity by the commutator. The operation is as follows:



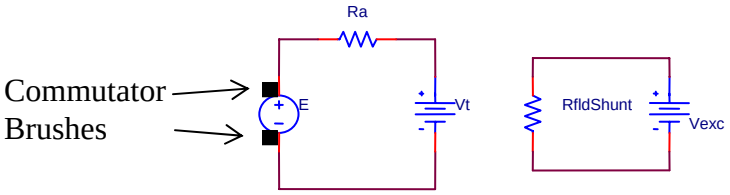
1. Rotor spins to align N-S and S-N
2. When poles are nearly lined up commutator flips polarity of rotor
3. Poles opposing, goto 1 and repeat

The commutator is configured in such a way that it reverses the polarity of the rotor every half turn, this keeps the poles from ever completely lining up and the motor continually spins.

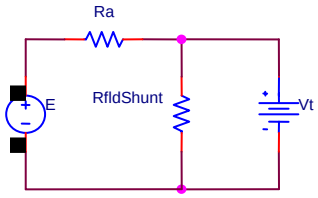
The Three Types of DC Machine Connections:

Most DC machines fall into one of three categories, Separately Excited, Shunt, or Series. The basic principles of operation are the same, what differs is how each connection is connected to the sources. A separately excited machine requires two independent DC source while the other two connections run off of one source. The diagrams of each connection are as follows:

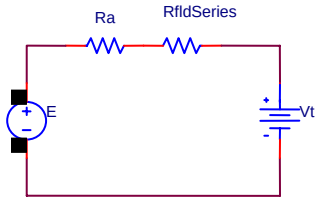
Separately Excited



Shunt



Series



Equations and Constants:

I_{FLD} = *Field Current* I_A = *Armature Current* $R_{FLDShunt}$ = *Field Resistance*

R_A = *Armature Resistance* E = *Back EMF* τ_M = *motor torque*

k = *Geometry Const* ω_M = *Rotor Speed* $\left[rad/\sec\right]$ N_M = *Rotor Speed* $[RPM]$

$$\omega_M = \frac{N_M 2\pi}{60} \qquad E = k\omega_M I_{FLD} \qquad \tau_M = kI_A I_{FLD}$$

→ To reverse spin direction, reverse either I_A or I_{FLD}, not both

Locked Rotor Test: $R_A = \frac{V_A}{I_A}$ Shunt Field Test: $R_{FLDShunt} = \frac{V_{FLD}}{I_{FLD}}$

Pulleys on dyno twice size of those on machine: $N_M = 2N_{DYNO}$, $\tau_M = 0.5\tau_{DYNO}$

At no load: $I_A = 0$, $V_T = E$