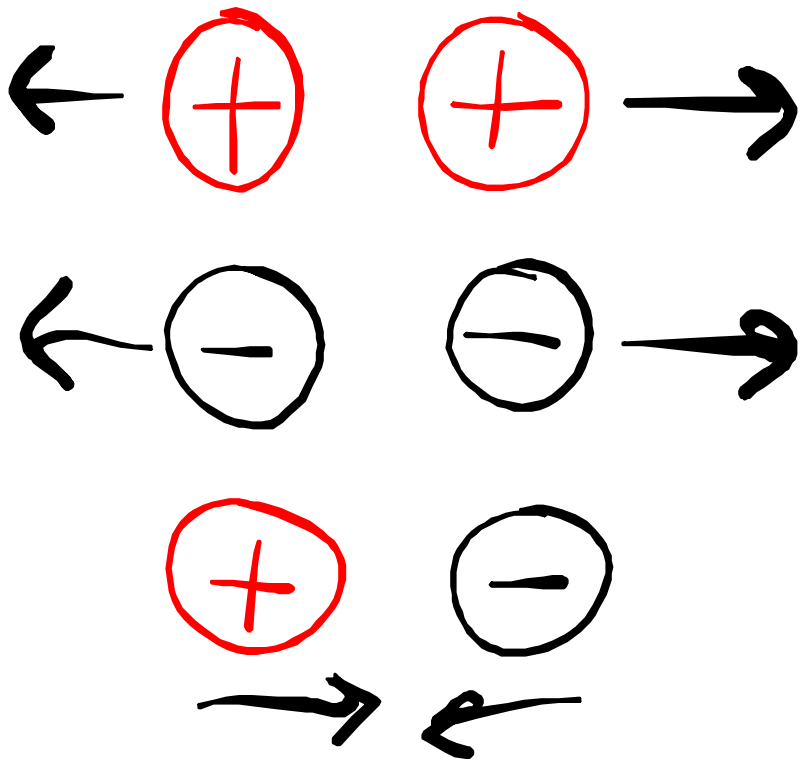
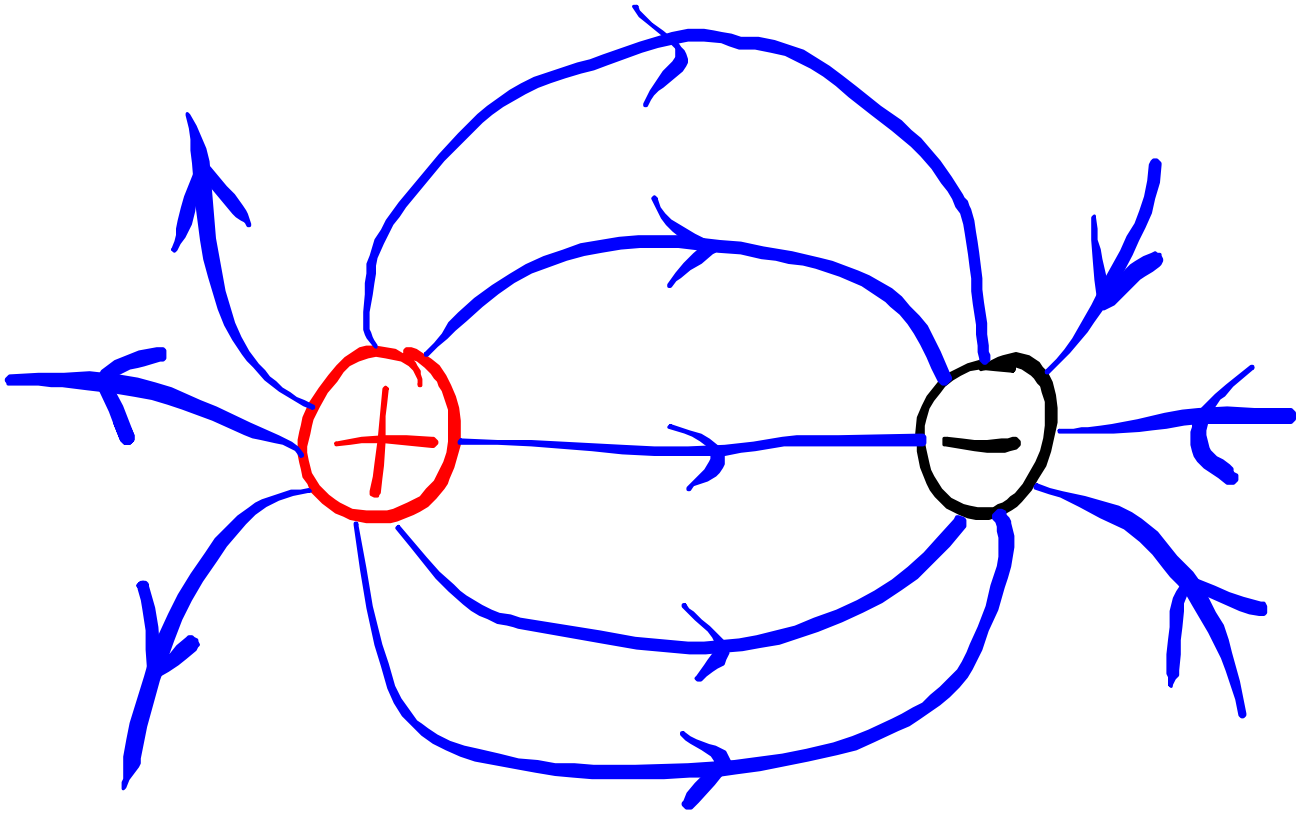
Forces and Electric Charge



Like charges repel

Unlike charges attract

Electric Field



Electric field lines move from positive to negative charges.
A charged particle experiences a force along the field lines

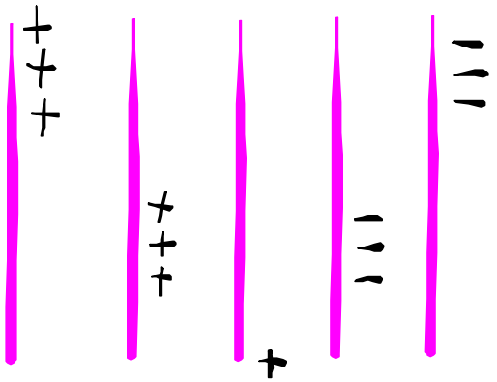
Magnets and Electricity

Electric charge creates an electric field (monopole)
Magnet creates a magnetic field (dipole)

Changing electric field produces a magnetic field

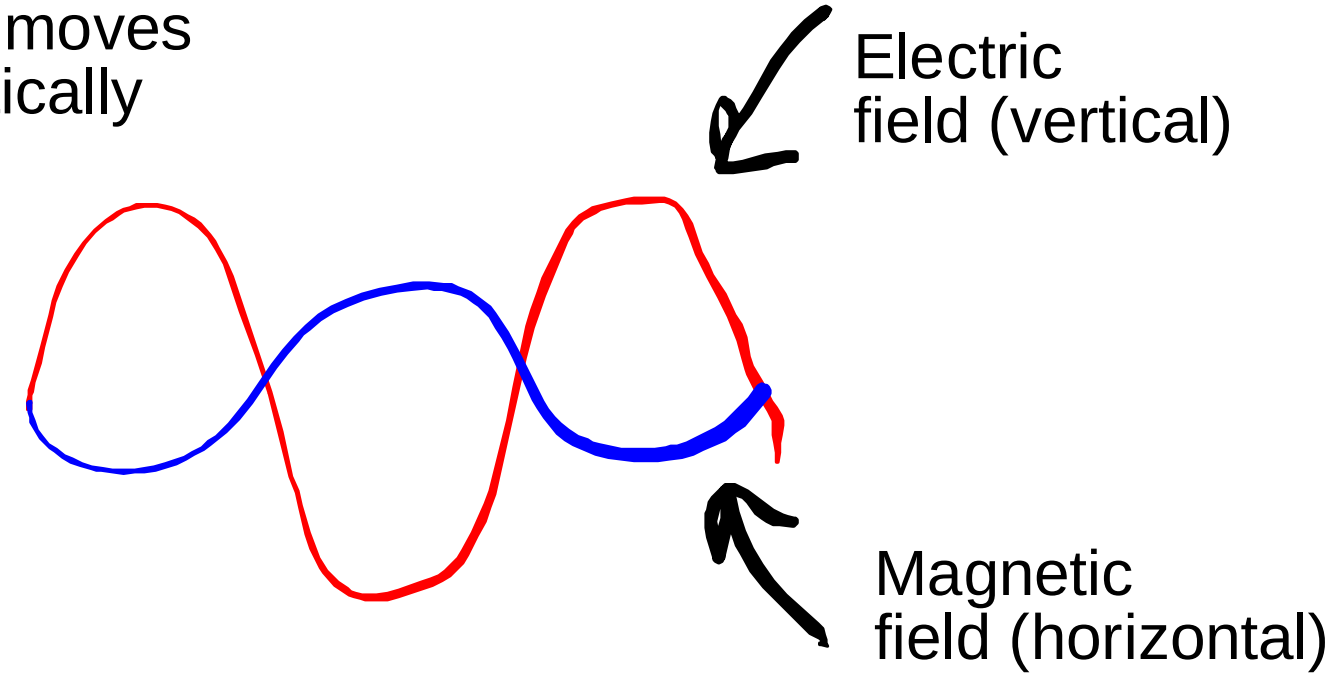
Changing magnetic field produces an electric field

Antenna



charge moves up and down the antenna, producing a polarized electric field (electric field only moves up and down, vertically polarized)

A vertically polarized electric field creates a horizontally polarized magnetic field

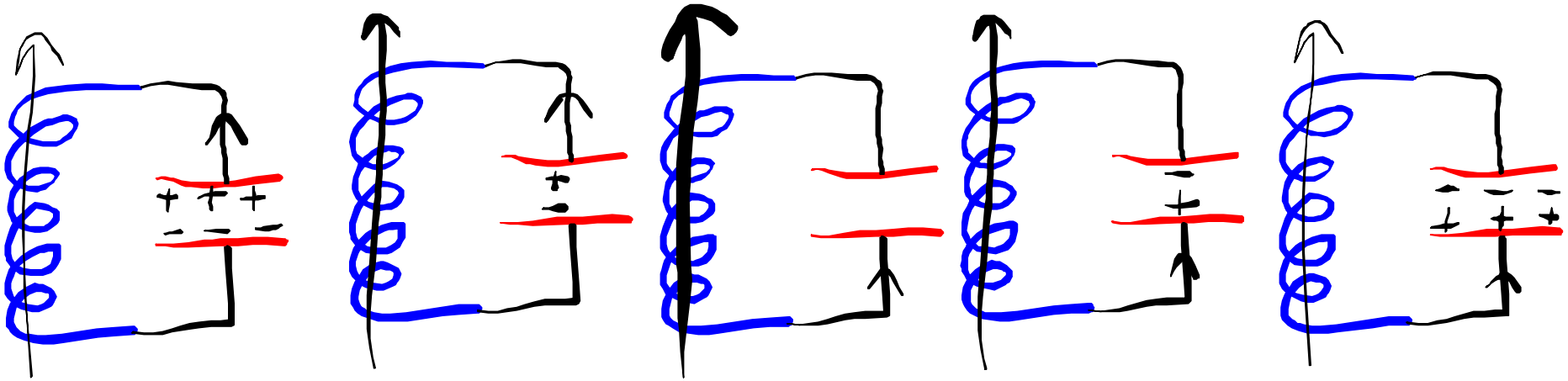


Tank Circuit

Inductor is a coil that creates a magnetic field (stores energy)
Capacitor stores electric charge (energy)

Lenz's law important here

Resonant electric circuit, frequency depends on inductance and capacitance



capacitor charged. no field

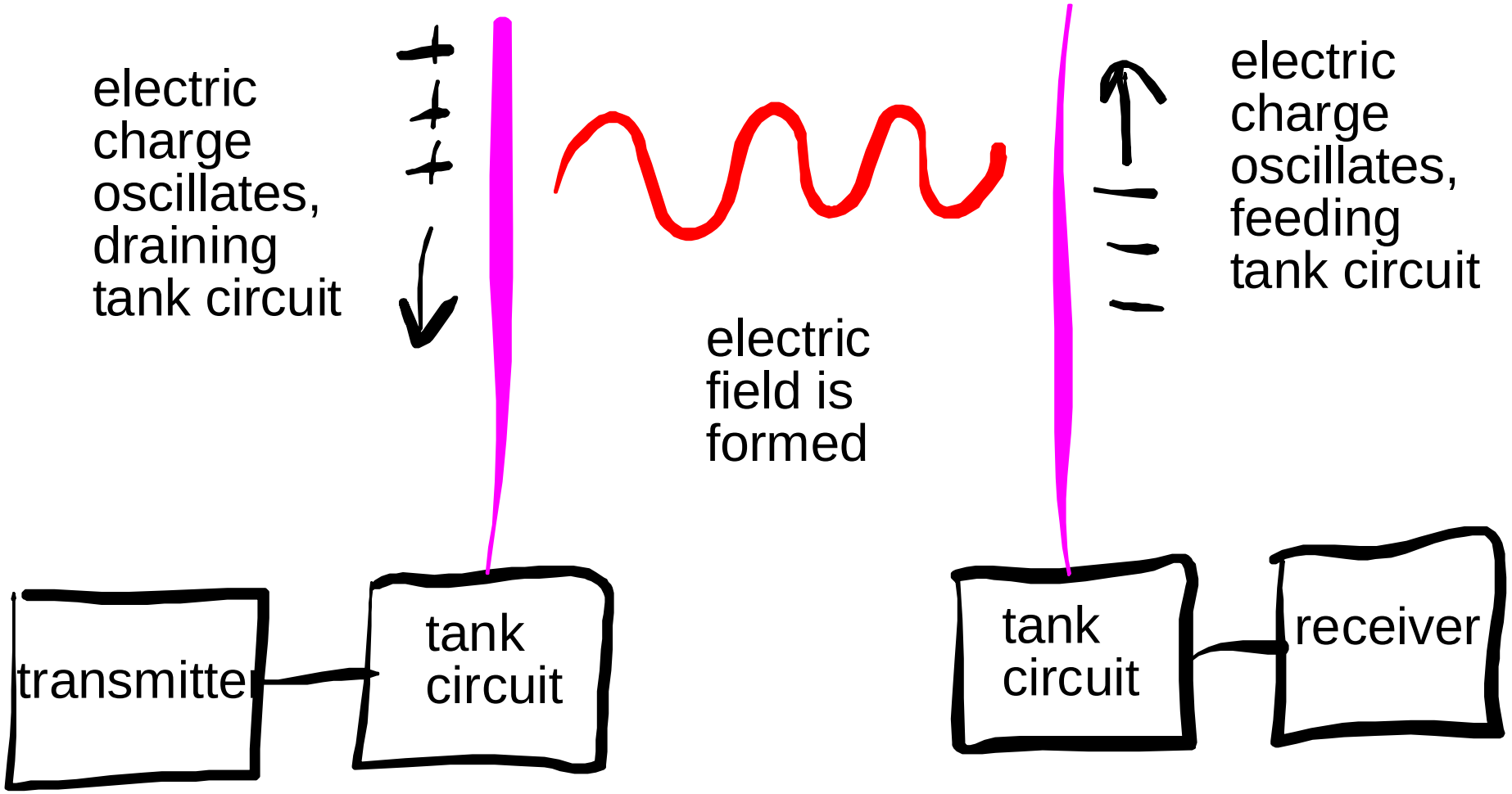
capacitor discharging, current flowing, field growing

capacitor discharged, maximum field

field reducing, capacitor charging

field minimum, capacitor charged

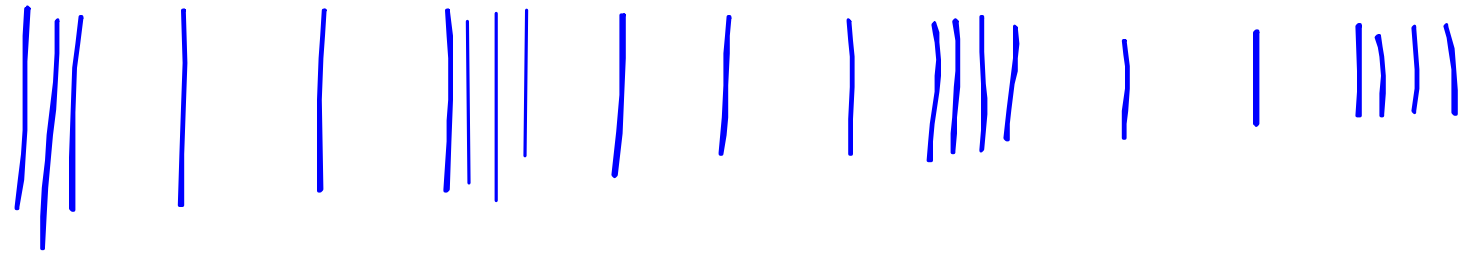
Radio Transmitter-Receiver

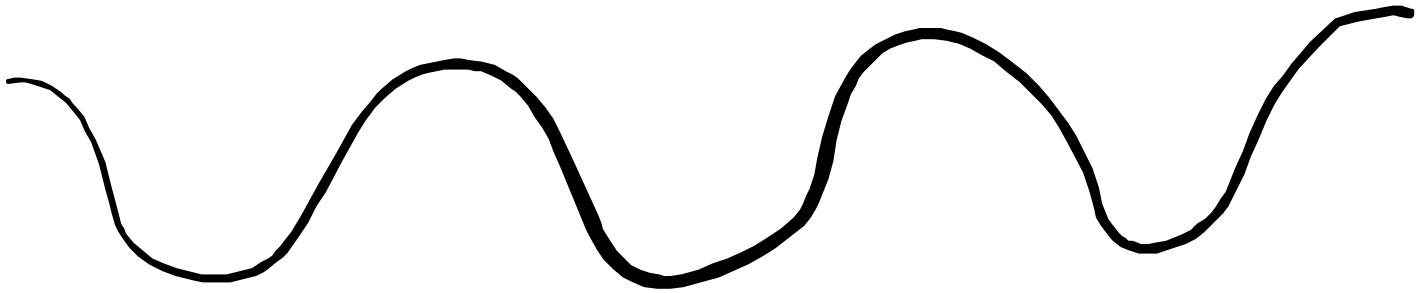


Works only if frequencies of tank circuits match
Tuning the receiver

Sound Waves

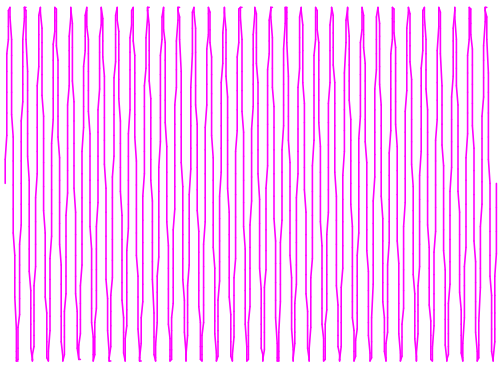
compressions and rarefactions of the air



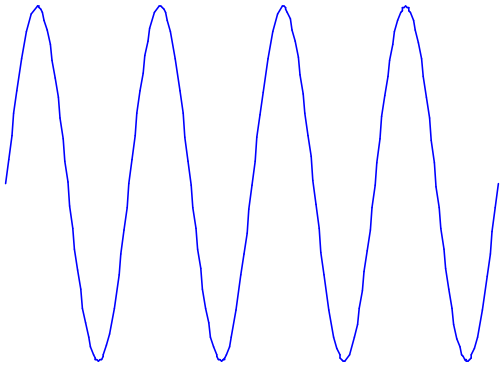


In a radio, need to send the frequency and amplitude over the airwaves (electromagnetic radiation)
Or just send the pressure on the air as a function of time

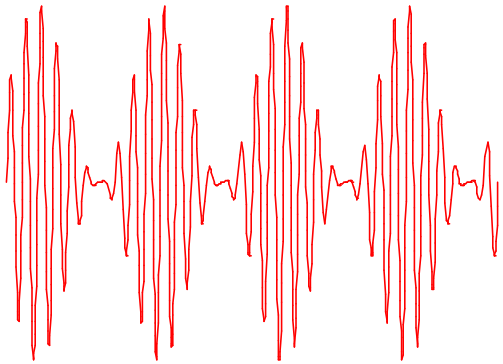
AM Radio
amplitude modulation



Frequency of AM station
(550kHz-1600kHz)

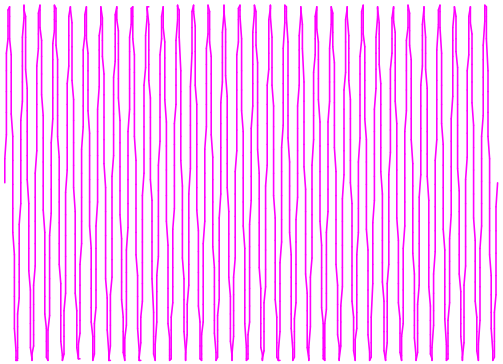


Sound wave to be transmitted

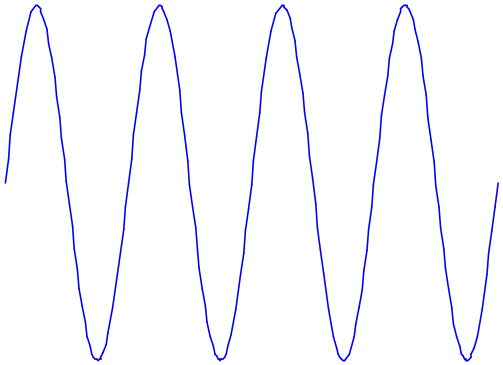


Radio wave from the transmitter

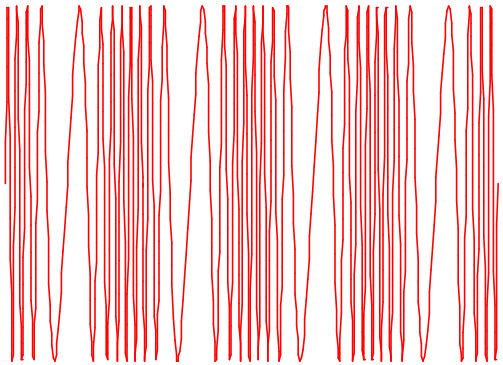
FM Radio
frequency modulation



Frequency of FM station
(88MHz-108MHz)



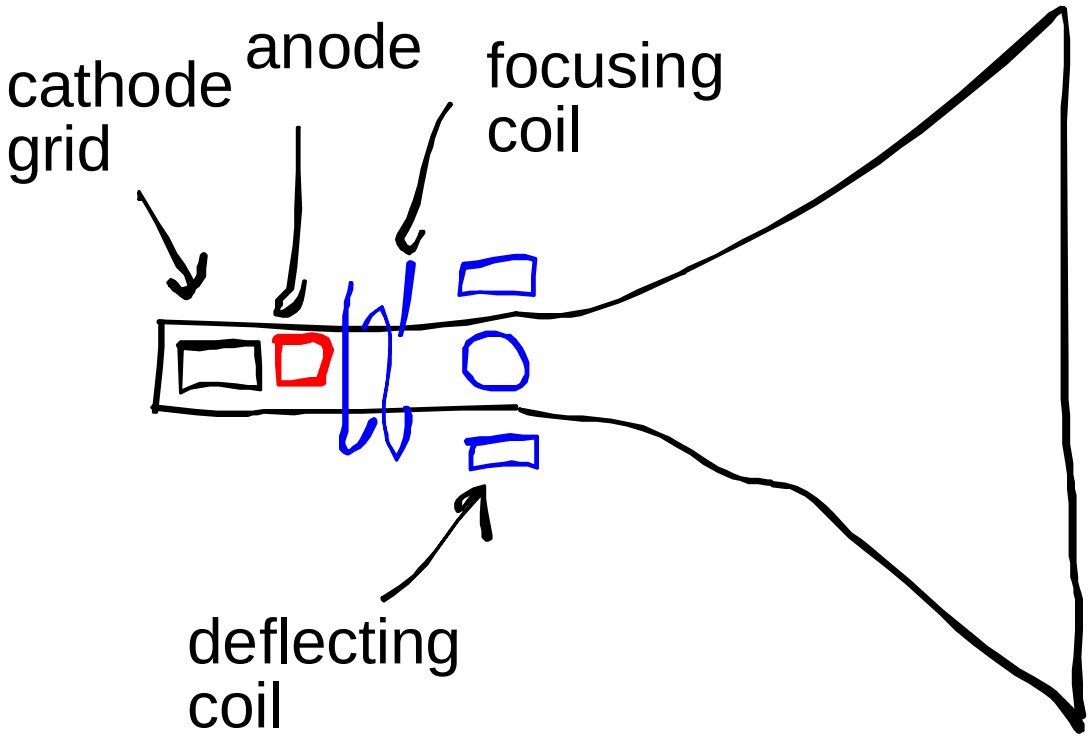
Sound wave to be transmitted



Radio wave from the transmitter

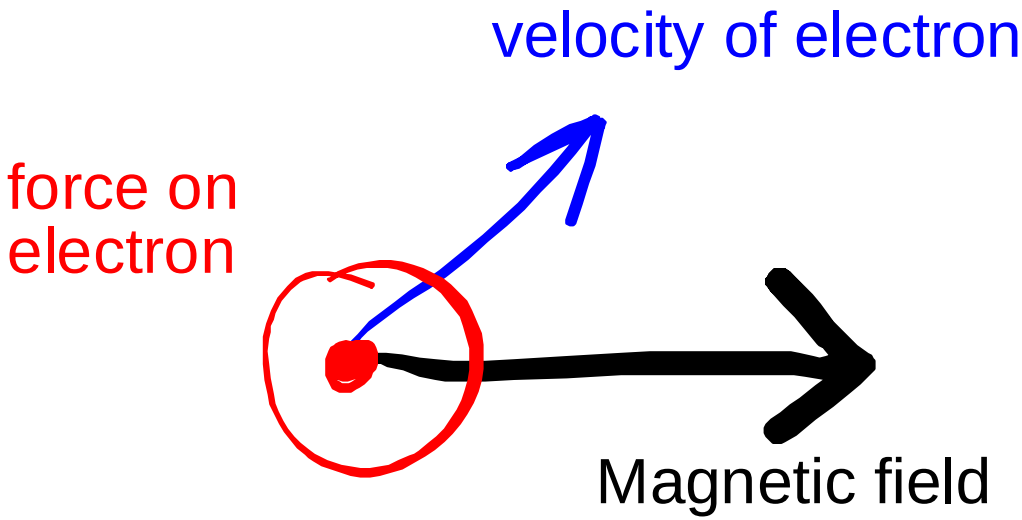
Television Tube (CRT)

Cathode Ray Tube (CRT)



Electrons are emitted from the cathode, selected by the grid, accelerated by the anode, and focused by the focusing coil. They are then bent by the deflecting coils.

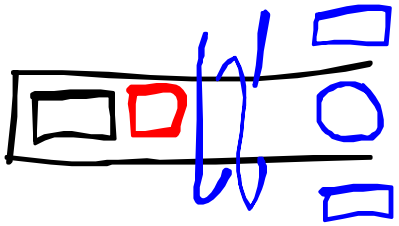
Magnetic Force



Charged particle moving through a magnetic field experiences a force perpendicular to both directions

Force on electron is out of the paper, electron bends towards you

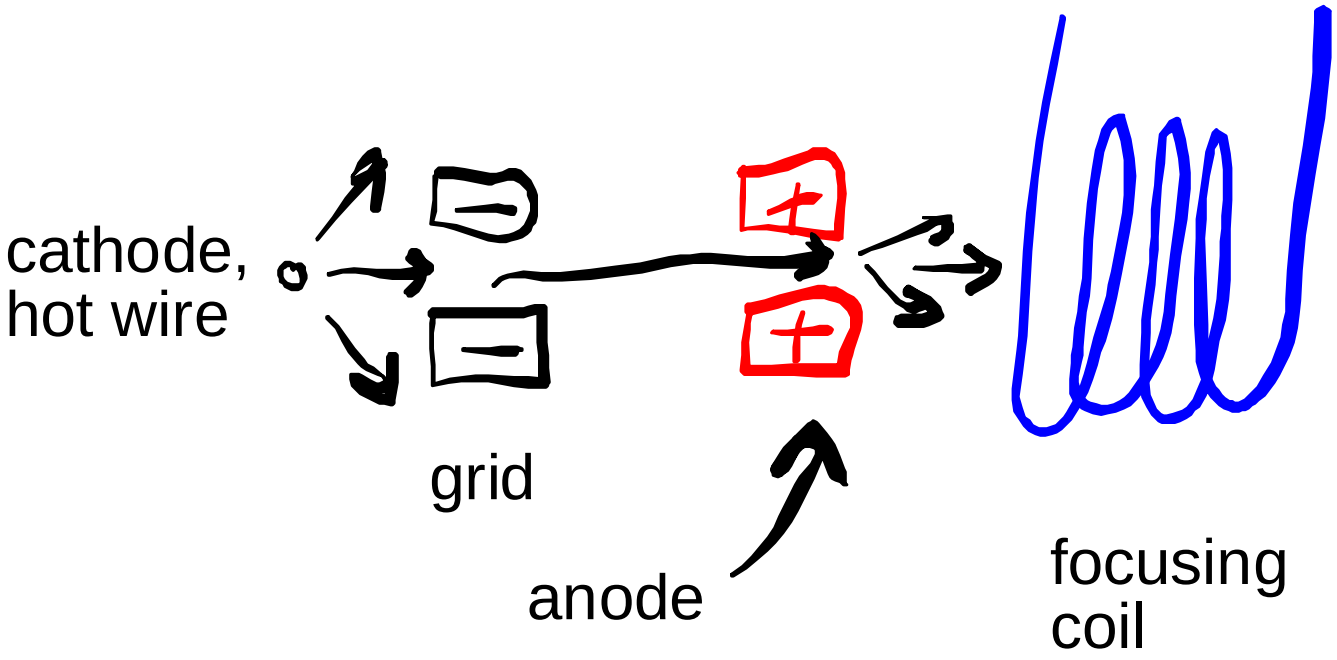
Electron Gun



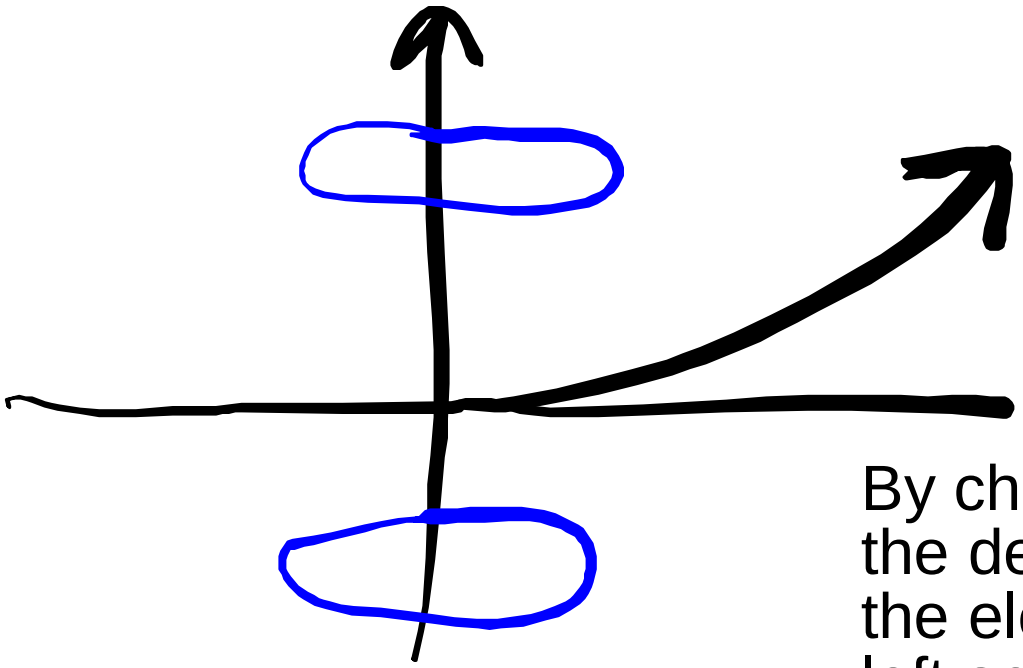
Electrons are emitted by cathode.

Change grid voltage to change electron beam intensity.

Focusing coil focuses electrons on phosphor screen



Deflection Optics

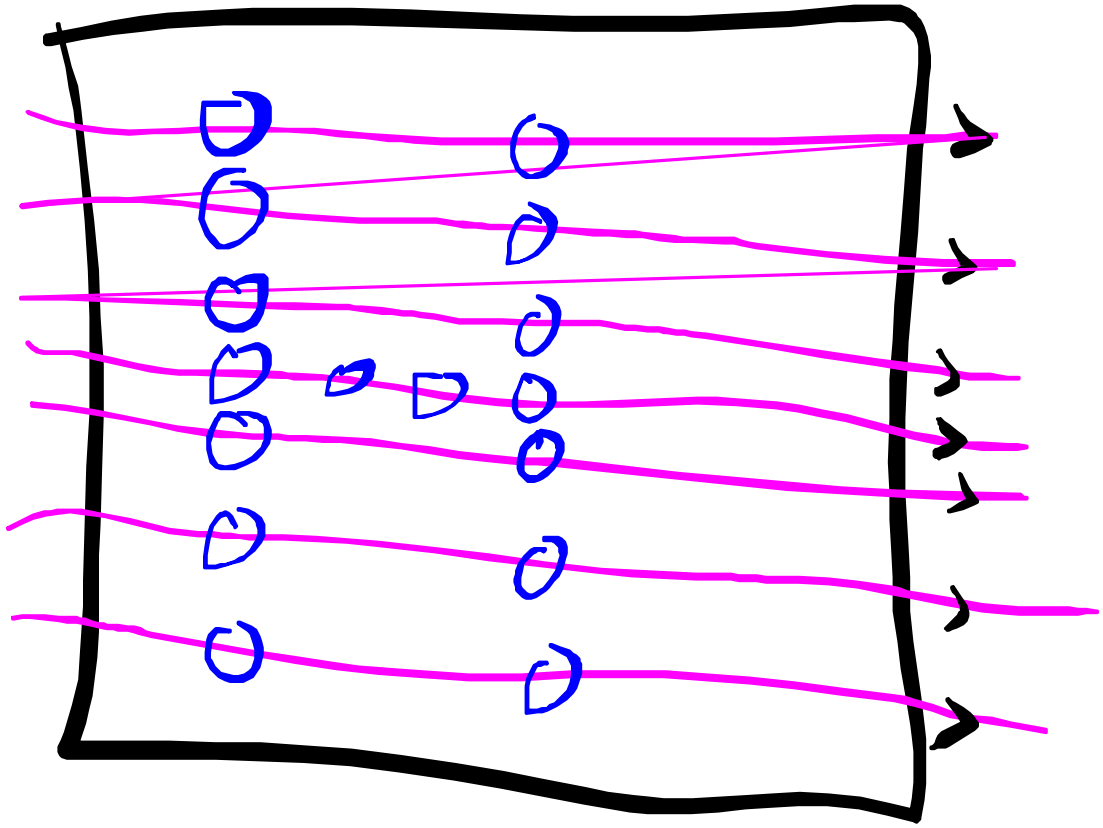


By changing current through the deflecting coils, can scan the electron beam right to left across the phosphor screen
(Similar for up and down)

More current, stronger magnetic field, more bending of electrons

Phosphor Screen
Black and White Television

Electron beam is scanned across phosphor screen

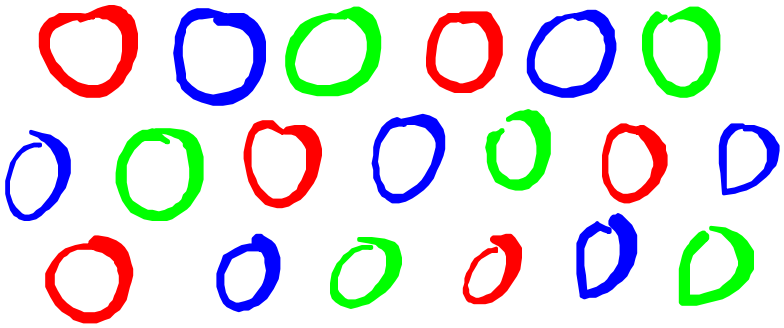


phosphor screen glows when struck by electrons

Change intensity of electron beam as the beam is moved across the screen to give bright and dark spots, forming the letter “H”

Total image is scanned 30 times per second (interlaced)

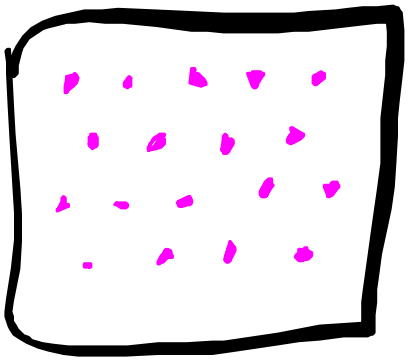
Colour Television



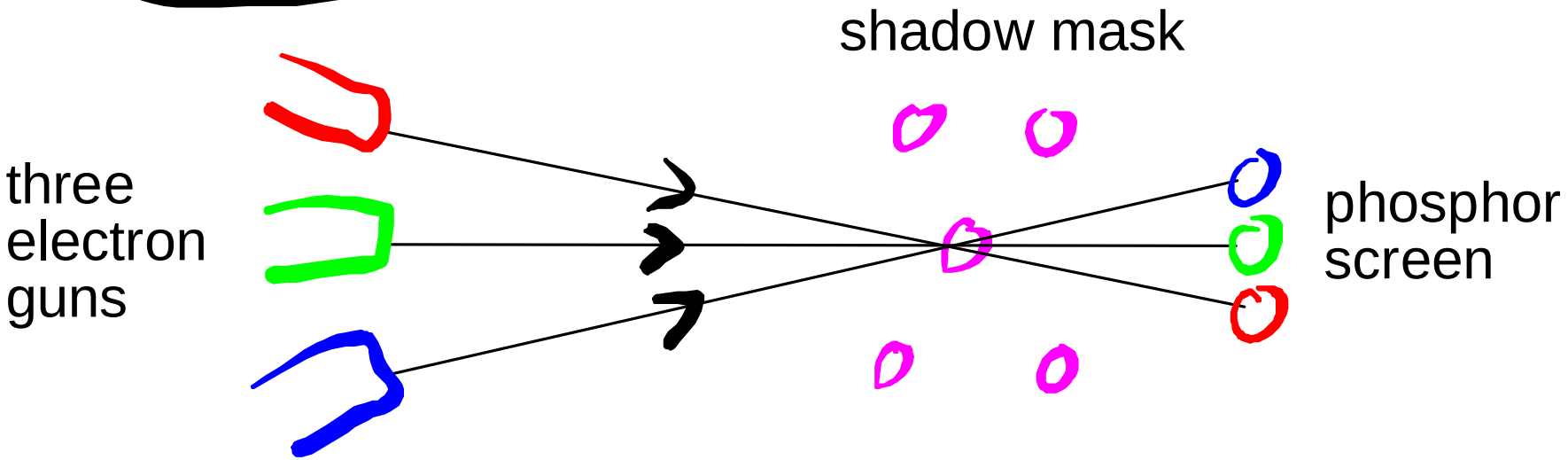
Make all colours by mixing
RED
GREEN
BLUE
(RGB)

Different spots on the phosphor screen, when struck by electrons, will glow in either red, green, or blue

Colour Television



Shadow Mask
Regular grid of holes



Three different electron guns,
each one focusing on shadow mask
and illuminating only one of
red, green, blue pixels on phosphor screen