AM Radio Transmitter and Receiver
Honors Physics 2 – Section H2
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Every day we use devices and equipment that operate off of radio waves- everything from cell phones, to GPS units, to garage door openers, and of course radios themselves. In order to further explore radio waves, I built an AM radio transmitter and an AM radio receiver. AM waves or Amplitude Modulation waves vary in strength according to the signal that they are carrying. The actual construction was fairly simple after some preliminary work. Both the transmitter and receiver required wires and components to be soldered together and thus I had to learn to solder. Only a few issues arose during this project (ummm…roommate).

The transmitter was constructed from a 1 megahertz crystal oscillator, an audio transformer, a phone plug, battery clip, a 9 volt battery, braided wires, and solid state wires (borrowed from an old doorbell). (See page 4 for schematic.) All were mounted on a printed circuit board. It was fairly straight forward to build and, except for a few cold joints, the soldering was fairly simple on the printed circuit board. The transmitter was connected to a CD player in the earphone port. The electricity flowed from the CD player to the transmitter in varying strengths depending on music being played by the CD player. The electricity from the CD player flowed into the transformer and then to the oscillator. This electricity combined with that from the battery and varied the amount of currents in the antenna from zero amps to ten amps. The alternating current in antenna produced electrostatic and magnetic fields around the antenna. These fields have energy and some of the energy became electromagnetic waves. The transmitter produced radio waves at a frequency of about 1000 Megahertz.

The transmitter was tested with a variety of CD players at different volumes. It was discovered that the amount of electric current flowing from the CD player to the transmitter greatly affected the radio signal. The higher the volume setting and thus more current the stronger the signal transmitted. Numerous radio receivers were tested with the transmitter and

found to receive the signal. The transmitter's range varied anywhere from about an inch to 2 feet. The quality of the signal has greatly varied from being very clear to where the music is barely distinguishable from the static. This could be due to the different types of electronic devices in the room when the transmitter was being tested and also radio stations transmitting at or near the same frequency.

Of courses anything transmitted needs to be received so an AM radio receiver was built. This was a unique receiver in that it was not built on a bread board or a printed circuit board instead it was mounted on three pennies, thus its name the Three-Penny Radio. The radio receiver would have been much simpler to build on a printed circuit board. Copper on pennies is much thicker than the copper on printed circuit boards and thus takes much longer to heat up. In fact, sometimes while trying to heat up the penny to add more solder, solder already on the penny would melt. The pennies look cool but are definitely not the prefer material to solder on. Parts used to build the radio included 3 pennies, a transformer, an AM Radio Integrated Circuit, a tuning capacitor, and a 0.01 microfarad capacitor. The system also required a 100,000 ohm resistor, a 1,000 ohm resister, two 0.1 microfarad capacitors, an amplifier, and speaker. (See page 5 for schematic.)

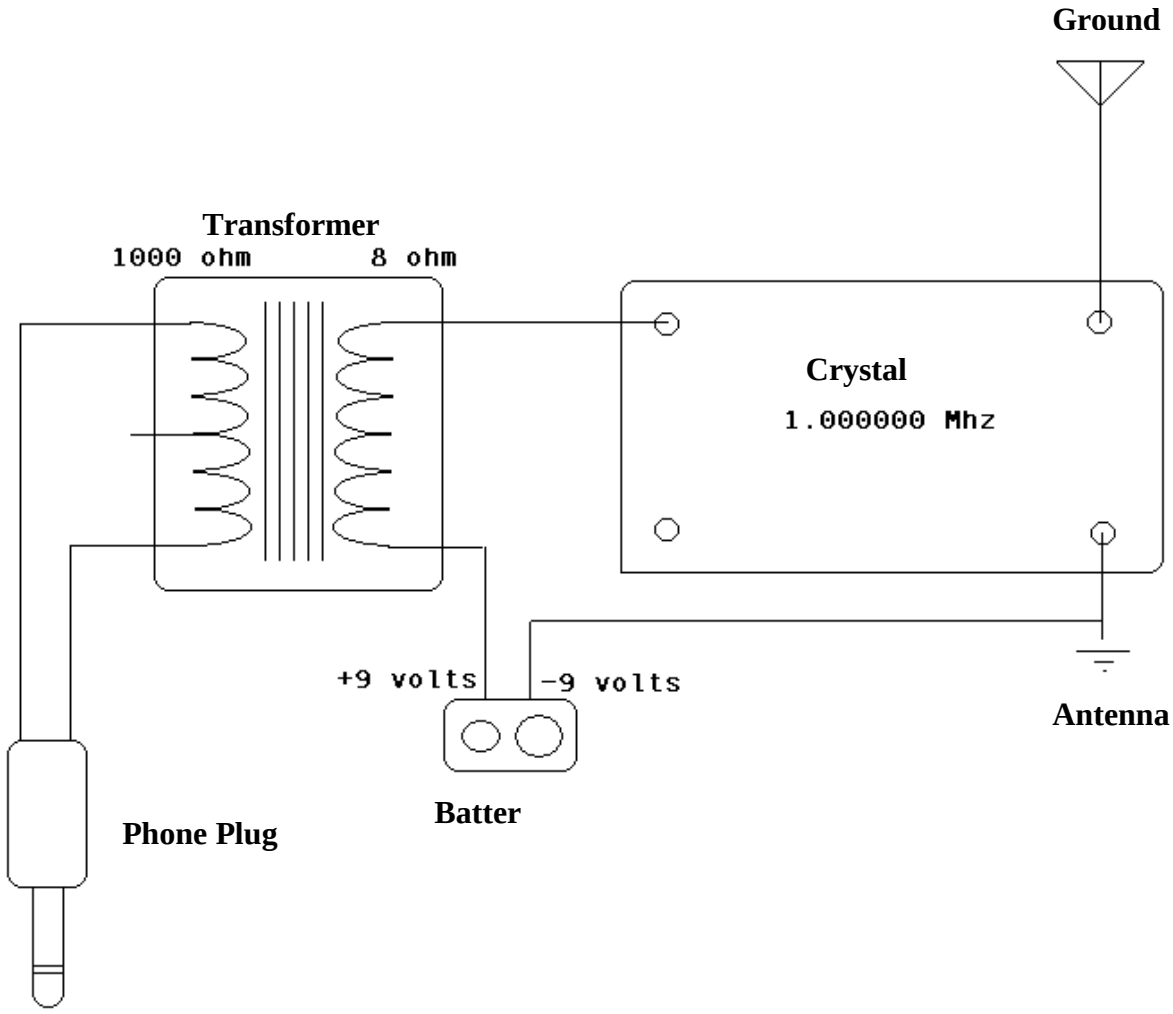
Initial the radio was built with a piezoelectric earphone, instead of an amplifier and speaker, but the radio proved to be more useful and easy to demonstrate with the change. The piezoelectric earphone was extremely sensitive and had an impedance in excess of 1 million ohms. When electricity flows through this earphone a thin piece of metal is bent causing sound waves. A regular speaker has an impedance of about 8 ohm, so a stronger current is needed to flow through it in order for it to produce a sound. The amplifier added to the system increased the current allowing the radio transmission to be heard through the speaker.

The electromagnetic waves produced by a transmitter travel through the air inducing tiny currents on metal objects. When the waves strike the receiving antenna of the receptor, an alternating current was induced. The amplifiers inside Integrated Radio Circuit amplified the current produced in the antenna with the current from the battery. The Automatic Gain Control, also in the Integrated Radio Circuit, managed the amount of amplification the current received. The AGC amplified weaker stations more than stronger ones so all the stations received had about the same volume. The current was then amplified more before passing through the speaker as mentioned earlier.

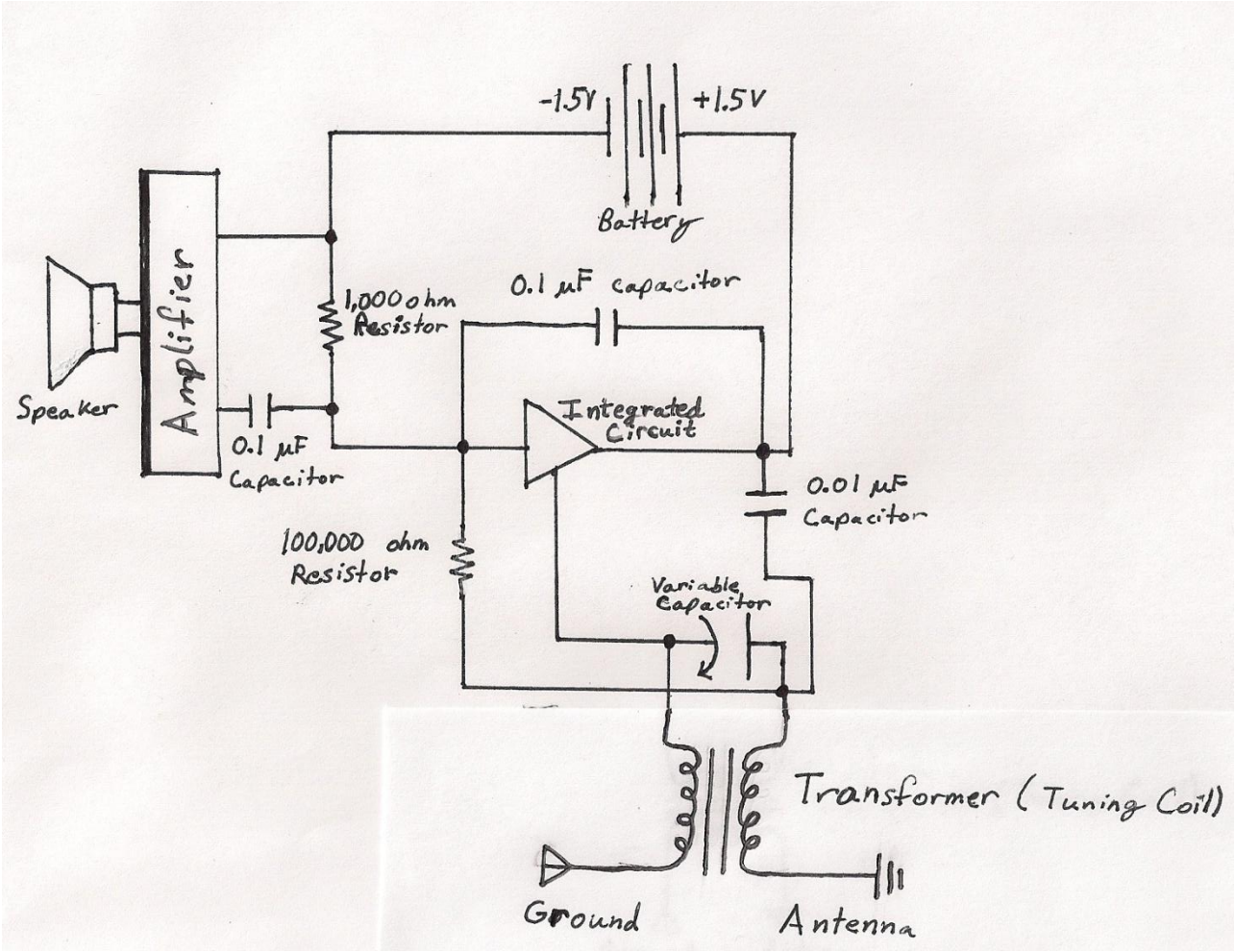
Many different frequencies of radio waves strike the antenna and the radio must be tuned in order for just one station to be heard. The radio had two different elements that could be used for tuning. It was roughly tuned by sliding the ferrite rod in and out of the transformer. Stations could be faintly heard without the rod being inside the transformer coil. But when the rod was completely inside, it increased the amount of current induced and the sound received was the loudest; the radio also seemed to produce less static when the rod was inside. On top of the variable capacitor there was a dial and by turning it the frequency being received could be more finely tuned. The turning of the dial changed the capacitance. The inductance of the transformer and the capacitance of the capacitor together determine the frequency the radio is tuned to. Four different stations have been picked up by the radio at various times and in one test setting three different stations were received.

In 1897 the first radio was patented. This discovery allowed for almost instantaneous communication of people and the invention of a host of other devices. The transmitter and receptor presented here were simple examples of the technology that has developed since that discover. Much was learned in the building of these two devices and both operated successfully.

Schematic Diagram of AM Radio Transmitter



Schematic Diagram of 3 Penny Radio



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