



A Flame RF Signal Detector Basic Radio Receiver Lee de Forest Candle Set

OddMix.com - Crystal Radio Note - CRN0902 - Karl Nagy

Warning, be very careful doing these experiments! Before you burn down the house, the town or hurt yourself, heed the ancient warning about playing with fire. **Do not do these experiments in or about a gas station, a barn or anywhere there is flammable material or fumes abound!** A fire extinguisher is also a necessary and useful item. Do not put your hands into the flame as you can get burned! **Notify your insurance company, and the local fire brigade** before start on these self-directed discoveries! Children should only conduct these experiments without close parental supervision, or not at all.

In any case, **OddMix is NOT responsible for the outcome of your research**, only that this information is technically correct! With this out of the way let's get into elementary plasma physics where this little gem of a radio receiver belongs.

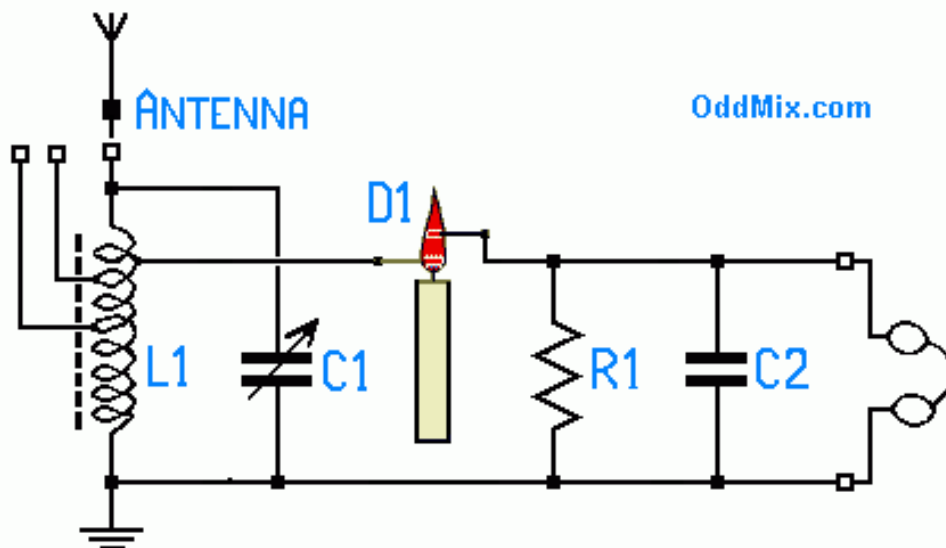


Figure 1. Simple flame detector radio.

Figure 1 shows a basic flame [detector radio set](#). The candle has two steel wires held in its flame, one above the other. Unbend some paper clips to get good useable wire, and support them securely on one side. Supposedly, **Lee de Forest**, in his quest to fame, busily investigated a similar [radio](#) circuit in what then he called his laboratory. As a result of this exact receiver experiment he **invented the triode** and eventually he made it to the electronic hall of fame!

Beginners construct this [radio](#), with a [crystal detector](#) in place of the candle, most often because of its inherent simplicity and ease of construction. This basic candle set has only five components. In spite it's ease of construction it performs well if a high-strung long wire, well-insulated antenna and a good ground, like a water supply pipe is available, or if strong stations are nearby. A short-wave version works great even with a not so good antenna almost everywhere when wave propagation is good.

The reason the flame radio signal detector works is because inside the flame there is a region called plasma, that is made up of ionized gas, that is a good conductor of electricity. It is important to place the electrodes one above the other, the bottom one into the hottest part of the flame. The signal detector works on this temperature difference. The hotter wire is more capable to emit electrons, and becomes the cathode, the other cooler one higher up in the flame works as anode.

Not only the flame is good for a radio signal rectifier, but also useable as a sensitive microphone and a wide frequency [speaker](#). Long time ago, the ancients noticed, that every time someone spoke in a quiet room illuminated with candles, the flames always flickered. That is because the flame is sensitive to otherwise invisible sound pressure waves. That is how the candle makes a microphone. Similar, much earlier observations may have resulted in using candles in a large number of religions around the world.

For more technical and construction details on the [basic crystal set shown on the figures check here](#). More general information is found with the other [OddMix crystal radio article collection](#).

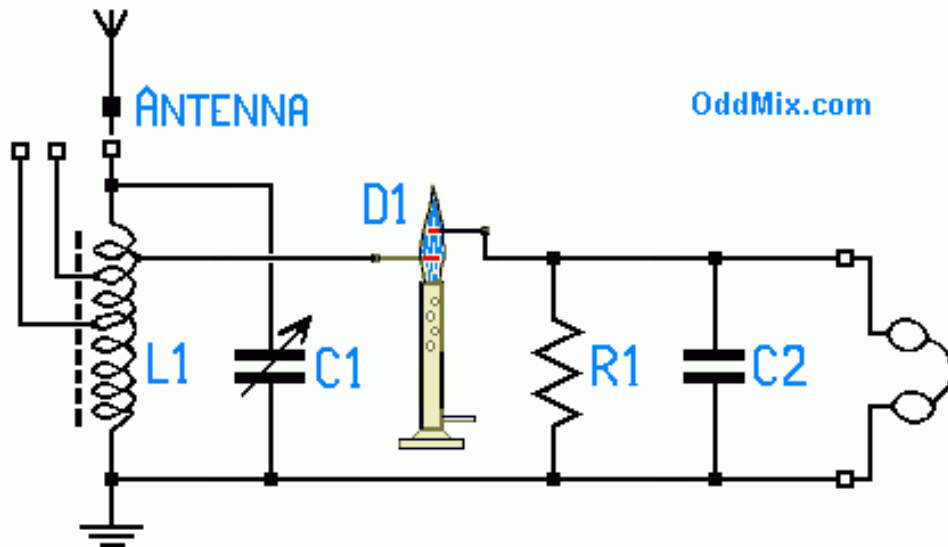


Figure 2. Deluxe flame detector radio schematic

Figure 2 shows the deluxe, high tech version of flame detector radio set. For those of you with Bunsen burners, would find them a bit more convenient than the candles as their flame stays at the same height since these burners don't melt when used as wax candles do. Also Bunsen burners have a much hotter and more adjustable flame. Set the flame to have the lower electrode emit a reddish glow. Almost any other gas flame is useable for the above radio experiments.

Parts list for simple five component crystal detector radio:

- L1 - Antenna coil - 75 turns 180 uH (micro Henry), Taps at 15 and 30
- C1 - Rotary Capacitor - 500 pF (pico Farad)
- D1 - [Diode](#) - D1 - Candle Detector, with two wires in the flame
- R1 - Load [resistor](#) - 200 K, used with crystal phones only
- C2 - [Filter Capacitor](#) - 1 nF, used with magnetic phones only

If sound frequencies applied to the two wires in the burner, the flame will act as a high fidelity speaker. The voltage of the sound signal needs adjustments to match the impedance of the flame. Flames with their plasma are close relatives to [vacuum tubes](#); therefore they tend to have high impedance. Luckily an old output transformer connected backward, the speaker side fed by the amplifier speaker terminals, and the primary side connected to the electrodes in the flame would work. For higher power, larger electrode area is necessary.



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