Bizarre Stuff You Can Make in Your Kitchen

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Foxhole and PoW built radios: history and construction

Building a foxhole radio is rewarding and the basic setup is very simple. It is, however, difficult to adjust, and it may take several attempts to find a proper razor blade for the detector. This is a project that requires patience and much trial and error, but it will pay off once it begins to work. It will help to be versed in the construction and operation of crystal sets before building one. It will be especially helpful to read the introductory notes about the coil, detector, antenna, and other components. These sets are extremely simple in construction, but tuning and modification require some basic understanding of theory, as well as practice. All sets presented here are based on old articles, notes, and people's recollections. There are fairly major variations in design and materials among these plans. It must be remembered that these were improvised under often adverse conditions; there was no "standard" design. With this in mind, take this entire article as a whole, and use it a bit here, a bit there, to build towards a design that works best using modern materials.

Update December 2006

I am in the process of revising this page, and I would like to add more of the history behind these sets. I have been doing a lot of research on these sets and I have come to realize that a lot of what was here was incorrect, so for now only this page will be on line. The historical pages will be back up eventually. If you or someone you know built a receiver like this, during wartime or otherwise, from improvised parts, or if you have or know of any surviving sets that I may photograph, please contact me at radio@bizarrelabs.com. Ultimately I would like for this page to be a brief history of these sets, told by the resourceful people who constructed them.

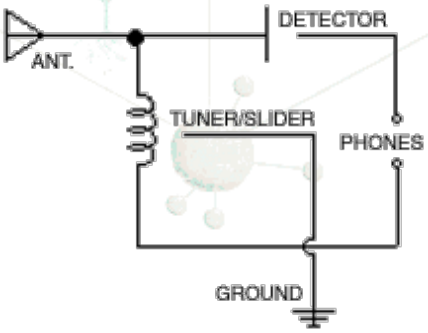
Set 1

GI's, during World War Two, built these sets which took advantage of (comparatively) readily available materials. The instructions are purposely lacking in detail; these were a project designed with improvisation in mind. It will help if you have had some experience with crystal sets before undertaking this project. It is very tricky to tune and properly set the detector. But once you get it working, you will be amazed that you can actually receive signals through so crude a device. This design has survived mostly thanks to the article *Build a World War II Foxhole Radio* by Lance Borden, as it appeared in the Electronics Handbook vol. XVII, p. 47.

The basic components are:

- Razor blade "PAL Super Single Edge" by American Safety Razor Co., or a regular rusty one
- Cardboard toilet paper tube
- Wire coat hanger or other handy strip of workable metal
- Headphones or earphone (2 - 4 K ohms)
- Large safety pin
- Lead from a wooden pencil
- #22 AWG (or so) wire
- Something for a base (small scrap of wood)
- Lacquer, glue

- Small tacks or screws for fastening components

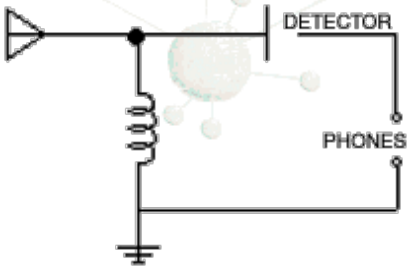


Refer to the schematic for wiring and connections. Wind the coil 100 turns around the tube. #22 AWG wire is recommended, but it is likely that whoever was in the field used whatever gauge was in the scrap coil, motor, or transformer they were cannibalizing. Spray / paint the coil with lacquer (or whatever is handy) to set it firmly. Scrape off whatever paint or varnish may be on the wire used for the tuner/slider. Spread the safety pin apart and bend the head 90 degrees to use it as a base for attaching the pin to the base. The pin should stick up from its bent head, then down to its point where the pencil lead is attached with some of the wire left from winding the coil. The sharpened pencil lead is the detector, which touches the razor blade, which is in turn attached to the base at one of its ends (through the hole) with a screw or tack. The tuner should be mounted so that it is free to pivot and slide across the coil (see the crystal radio page for basic construction tips). Use a scrap of paper or cardboard as a template for getting the tuner/slider the correct size. Sand off the varnish on the coil where the slider will touch it. Connect the ground and antenna, hook up the headphones, and through much patient adjustment of the detector and slider, you should eventually be able to pick up broadcasts. A capacitor (.001 - .002 uF) between the earphone terminals improves performance. I have seen more than one example where a cap was improvised from cigarette foil, cut into strips and stacks (the paper backing served as the insulating layers). Simple variable capacitors (condensers) may have also been easily improvised.

Another reader writes that he had success using a blued hacksaw blade (he didn't specify how big of a piece) and a hard drafting lead. These days, a blued hacksaw blade is much easier to find than a blued razor blade!

Set 2

The simplest of these wartime sets didn't include a slider/tuner arm, and were therefor capable of only tuning in one frequency. An article appeared in a 1944 issue of QST, and is faithfully reproduced in the D J Adamson Collection pages, so I won't go into a lot of detail here except to include the schematic. I highly recommend visiting Mr. Adamson's pages if you are interested in old radio (or stereography).

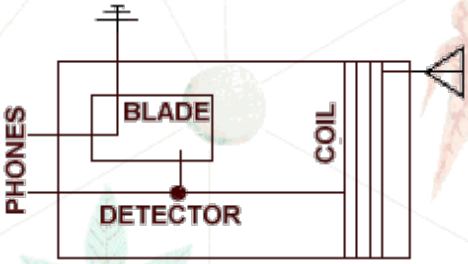


Not much can be said about so simple a design. The coil was 120 turns around a 2" form (toilet paper tube). The whole thing was tacked down to a board. Pencil lead wasn't used at the time, instead the safety pin point directly contacted the blue (or rusty) razorblade. There is no tuner, of course, so only one signal will be received, and only if there is a station broadcasting near the correct frequency!

Set 3

I have been told that often these radios were constructed even more simply. The whole thing would have been built on a small, thin piece of wood or shingle, about 1/8 to 1/4 of an inch (3-6 mm) thick, 1or 2 inches (25-50 mm) wide, and 3 or 4 inches (75-100 mm) long. The coil was wound around one narrow end (I am not certain how many times... start with 100 and experiment). The blue razorblade would have been screwed or tacked down (at one of its ends) at the other end. The safety pin and pencil lead (if there was a pencil lead, which there probably

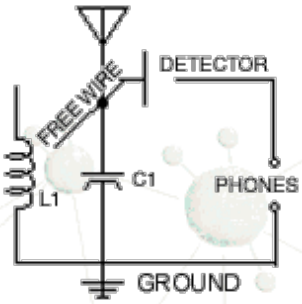
wasn't) would have been rigged up in the same manner as in the above sets.



From what I can tell, there would have been only 3 terminals, one securing the antenna wire and one end of the coil; one with the detector (bent safety pin head) and one of the headphone wires; and one with the razorblade, ground wire and the other headphone lead. I have not built one of these. This is based on a sketch I made which in turn was based on the description of someone I briefly chatted with a long time ago, who himself constructed the thing much earlier. It is possible something was left out, so it may take a lot of tinkering to get it to work (if it works at all). Once I get around to building one of these myself, I will add to this page whatever tips I can (assuming I can get it to work!) I would also enjoy hearing if anyone else completes a working model.

Set 4

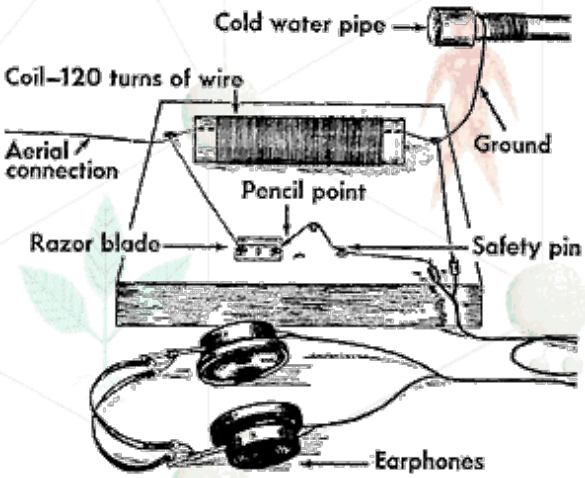
I have recently come across a sketch of a set that looked exactly like set 2 on the Crystal radio page, except it had a razorblade/pencil detector where the diode would have gone.



There was no "standard" design. They all used razorblades, usually blue, but the other components and configurations varied greatly. I have even seen a reference to a set that uses two blades, stuck with one business end in the board, and inch or so apart. I don't have any details about the circuit, but wires ran from each blade, presumably either between one of the headphone terminals and the antenna, or between the ground and the antenna. A pencil lead spanned the blades, resting on the sharp edges.

Set 5

This is paraphrased from the article "How to Build a 'Foxhole Radio' ", from*All About Radio and Television*by Jack Gould, Random House, 1958.



The illustrations are by Bette Davis (a different Bette Davis, I imagine). The book is long since out of print, and too dated for most libraries to hold a copy. It is a simple set, much like Set 2, but curiously it does not include a slider for the coil, even late in the article after the razor blade is dropped for a crystal and a condenser is added.

Tools required are:

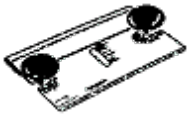
- A hammer
- A pair of pliers
- A pocket knife

Parts

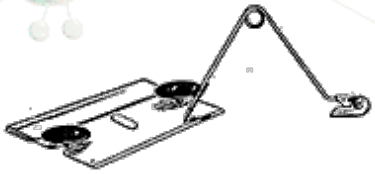
- Board, at least 8 inches by 6 inches (200 by 150 mm)

- Cardboard tube, 2 inches in diameter by 6 inches long (50 mm by 150 mm)
- Insulated (enameled) copper wire, 28 gauge
- Pair of crystal earphones (which in 1959 cost 2-3 dollars U.S.)
- 3 new nails
- 4 metal thumbtacks (not plastic push pins)
- A used blade that fits a safety razor. A plain white looking blade often works better than "blue" blades (direct quote)
- Big safety pin
- Pencil with a fat lead

Make 4 little holes in the cardboard, 2 at each end, with one of the nails. Push about 6 inches (150 mm) through hole 2, and then pull the wire up through hole 1. Wind the wire around the tube, making sure the turns lie side by side and not on top of one another. Wind for a total of 120 turns. Afterwards measure off 6 more inches of wire at the end and cut. Push the end of the wire down through hole 3 and up through hole 4. Lay the coil on its side at the back of the board. Fasten it to the board with 2 thumbtacks, making sure the thumbtacks do not touch any of the wire.



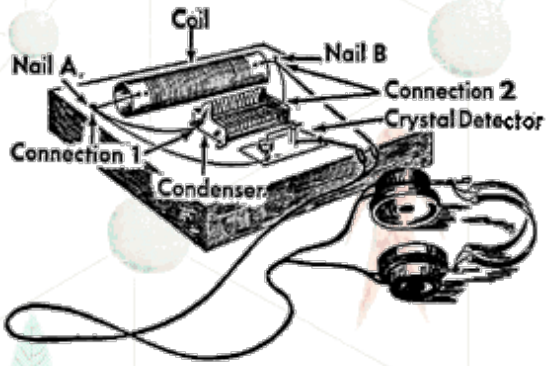
The razor blade is placed in front of the coil. Lay it on the board, and gently fix it in place with two metal thumbtacks. Do not push the thumbtacks all the way in.



Sharpen the pencil so there is a long piece of lead showing. Break off the lead, and wire it to the tip of the safety pin. Bend the head of the pin back so that it will lie flat on the board. Place the pin to the right of the razor blade. Hammer a nail through the head of the pin until it almost touches the pin.

Remove the insulation from the ends of the wires coming from the coil, as well as from the ends of all wires used to make connections. Hammer a nail just to the left of the coil. Leave it sticking up just a bit. Wrap the bare wire from the end of the coil around this nail. Take another wire and wrap a bare end around the thumbtack holding the left side of the razor. Push the tack all the way down to make contact. Take the other bare end of the same wire and wrap it around the nail.

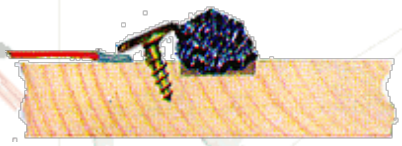
Hammer a nail to the right of the coil and attach the coil wire as above. Use another wire to connect from this nail to one of the terminals of the earphones. Take another wire and wrap the bare end around the nail holding the safety pin. Hammer this nail in to hold the wire in place, but not so tightly that the pin cannot move a little. The other end of this wire attaches to the other free end of the headphones.



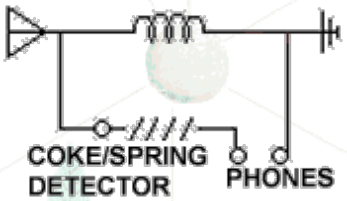
The antenna attaches to the nail that connects with the coil and razor blade (A). The ground wire attaches to the other nail, where the coil connects with the earphones (B). Hook up the headphones, and gently move the pin and pencil lead across the razor blade until you hear a broadcast. Once you hear it, don't move the pin, because you are more than likely going to lose it if you do. If there are more than one stations nearby broadcasting near the same frequency, you are likely to hear overlap. To solve this, you can add a condenser. A variable type can

be used, as in the illustration. It is recommended that it have 17, 19, or preferably 21 plates. Or you can use a fixed capacitor of around .002mF, or you can build your own (see the condenser article on the Crystal page). If a variable condenser is used, the post attached to the fixed plates should be connected to the nail that connects the coil to the blade (A). The condenser's other post is attached to the other nail (B). Once a station is found using the pin and blade. The condenser is turned until the signal becomes clearest. Also note that in the illustration a crystal and detector have been substituted for the razorblade. The wire that was attached to the blade is attached to the crystal's post, and the wire that was attached to the pin is attached to the detector's post. A safety pin can still be used instead of the cat whisker (see the introduction of the Crystal page).

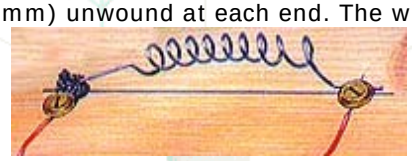
POW Radio



Prisoners of war during WWII had to improvise from whatever bits of junk they could scrounge in order to build a radio. One type of detector used a small piece of coke, which was a derivative of coal often used in heating stoves. The piece of coke used was small, about the size of a pea. A small board was used and a depression was cut into it near one end to hold the coke. A screw and, if available, a screw cup were used to hold the coke in place. A wire lead to the receiver was run from this to the coil/aerial (see Set 5).

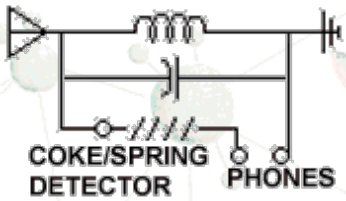


A foot or so (30cm) of steel wire (guitar wire, piano wire, etc.) was wound around a pencil, long nail, or similar, leaving about one inch (25 mm) unwound at each end. The wire should be somewhat springy.A



second screw and screw cup is set about 3 inches (75 mm) from the first. Attached by this screw are one end of the steel wire spring and a second lead, which is connected to one lead of the headphones or earphones (if anyone has any information on how earphones from these sets may have been improvised, I would like to hear about it). The steel spring wire was then stretched so that it just rested on the coke. After much adjusting of the point of contact on the coke and the tension of the wire, some strong stations would have been received.

If the POW was lucky enough to scrounge a variable capacitor, the set could possibly receive more frequencies.



A POW camp radio's construction described

The Centre for the History of Defence Electronics Museum has posted an amazing interview with Lieutenant Colonel R. G. Wells, who built a rather elaborate set out of scrounged and improvised items while in a POW camp during WWII.

Improvised diode

The following appears word for word on my crystal radio page, but bears repeating here:

If you want to try your hand at making your own diode, Allan Charlton, of Sydney, Australia, adds:

"When I was a kid in a small town in Tasmania, Australia, our school was at the base of a hill, and the local radio transmitter was on top of the hill. We had lots of fun with crystal radios.

This is how we made our diodes:
Take a small length of glass or plastic tubing--an inch of the case of a plastic pen works well. Close one end with wax, sealing a wire through the wax. Pour a little copper oxide into the tube: enough to cover the end of the wire. Fill the rest of the tube with copper filings or turnings. Poke a wire into the copper filings or turnings (but don't let it go down to the oxide) and seal the end of the tube with wax.

Can't find copper oxide?
Throw some copper wire into a fire. When it's cool, scrape the oxide off the wire. Yes, there are two oxides of copper, a red oxide and a black oxide, and they both work well. We preferred the red, but I have no idea why."

But what about the earphone?

Richard Lucas, who was a POW in Vietnam, built a radio in camp and was also able to improvise an earphone. He writes:

> Four nails were bound together with cloth from our clothes.
>
> Wire was obtained from wire used around the camp which I might add wasn't coated with varnish. It was bare wire, so we wound a layer and, using a candle, we dripped wax over the turns, which were spaced as closed as possible without shorting out (not touching). We repeated this process over and over again until we had about 10 layers of wire, which were insulated from each other layer by a strip of cloth and wax. Then we put this in a piece of bamboo and adjusted it so it was about a 1/32 of an inch from the end.
>
> A tin can lid was positioned over the coil of wire and nails. Then connecting it to our "foxhole radio" (basic design as yours) we could here about three radio stations. Our antenna was the barbwire around the camp and the ground was wire laid along the ground to make up the ground. Best listening was at night and it had to be pretty quiet because the earphone was pretty weak. If we had a magnet to set up a bias on the coil, the volume would have been a lot louder."

And Mike Barnard points out that "the headphones were almost always acquired from a tank crew's radio operator, and often one side of the headphone was cannibalized for wire to wind the tuning coil while the other was used for listening."

If anyone else has anything to add concerning the history or operation of "foxhole" radios, especially those of you that constructed one during any of the wars, I would be interesting in adding your comments or stories here.

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