announcing
"OPERATION CRYSTAL"

a
challenge
to
all
radio
amateurs

Your solution to this problem will prepare your family and your community for emergencies

OLD-TIMER AND NOVICE ALIKE CAN MAKE A VALUABLE CONTRIBUTION TO THE PUBLIC WELFARE IN "OPERATION CRYSTAL"

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Disaster... no radio, no newspaper, no telephone... Hurricane? Explosion? A-bomb? H-bomb? How many bombs? What should you do to save yourself and your family?

Your car radio soon goes dead after you run out of gas... but the disaster goes on, gets worse... two days, three days... no trains, no trucks, no food... you recall how easy it was to get information with radio, newspaper and telephone.

The third day your neighbor's portable radio goes dead... the storekeeper laughs when you mention batteries... you remember how fresh milk used to taste... and you say you'll never eat cold canned food again, if you get out of this...

If you get out... but you can't get out without information! Is help on the way? Or are worse disaster areas taking up all the relief? Should you start hiking? Which way? North? South? East? West? Will there be more bombs? More hurricanes? Where will they hit? And when?

Still no radio, no newspapers, no telephone... just rumors—wild, contradictory rumors that may lead you the wrong way... one neighbor says flee... another says stay.

Superhuman effort has kept one broadcasting station on the air, perhaps on the Conelrad frequency. But you can't hear the official reports and advice without power or batteries.

What is the answer? You, the radio amateur have the answer—right in your junk box. You guessed it. A crystal diode detector.

There are probably as many ways to hook up a powerless diode detector in an emergency as there are amateurs. What works best on the broadcast band in your locality?

G-E HAM NEWS will award $10 tube certificates for the three most outstanding emergency crystal diode designs submitted for publication for each issue during 1955. In addition, we will award copies of our first Bound Volume (plus a complete set of subsequent issues) and one-year subscriptions to G-E HAM NEWS for other designs accepted for publication. Be sure to include in your contribution some notes on local receiving conditions. DO NOT SEND IN YOUR MODEL. All material submitted becomes the property of G-E HAM NEWS.
During a recent hurricane, our editor was visiting in New Jersey. Although the storm merely jostled the community, 25,000 homes were without power for the entire week-end.

Fretting because he couldn't turn on the BC set to learn about progress of the storm, it occurred to W2ZBY that every home ought to be equipped with a crystal detector for emergency purposes—and, furthermore, that the neighborhood hom is the logical person to show folks how to provide themselves with such an affair.

Impressed with the endless variety of crystal set designs possible with modern components, we decided to ask you fellows to help. Receiving conditions vary almost from house to house—depending on signal strength of local broadcasting stations, available space for antennas, the character of grounds, and so on ad infinitum. Here is a discussion of some of the basic principles and how they have been turned into practical circuits by a few of the G-E hams. Old timers' experience should enable them to make significant contributions to this emergency and civil defense need. But that's not to say novices can't do just as well or better. And, incidentally, what better way is there for a novice to get some basic practical experience with tuned circuits?

Let's have your contributions, fellows.

---Eighthorse Larry

The basic component in a simple radio detector is a rectifier to pelt the audio envelope from the incoming RF signal. In the early days of crystal sets a small chunk of the mineral galena was found to be a pretty "hot" rectifier. The rectified signal was taken off the piece of galena with a very fine wire called the "cat whisker."

The big trick was to find a good "sensitive" spot on the galena. This inconvenience is eliminated today by germanium diodes which now are turned out like buttons. Thus the germanium diode—often called a crystal diode—looks like a good bet for simple diode detector design.

However, it might be worth mentioning at the outset that a poor connection caused by rust or corrosion of the rectifier—diode—and, to a lesser extent, the cat whisker causes the circuit to operate in a "semi-conductor"-passing RF current in one direction.

Every once in a while one finds a radio-recipient system attached to the corroded metal—like, for instance, a bathtub of proper dimensions with rusty pipes—and, to a lesser extent, we actually have a "singing bathtub."

This phenomenon, of course, the basis for the old-old tales in ham circles about the old lady next door complaining the can hear your voice Q'O'ing in the gold to her teeth or booming out of the drain pipe in her sink.

A fellow located close enough to a high power broadcast station often can pick up the local program by putting on a pair of headphones and touching the pin tips to his water pipes, a window screen or his bed springs.

A slightly more complicated—but very un-electronic-type of rectifier can be made with a pair of razor blades, a bar of soap and a needle. Another version—reported from Alaska—is a "blue blade" and a safety-pin used as a "cat whisker."

However, for more reliable performance, it is best to suggest the crystal diode. And this can be hooked up in a variety of ways. Perhaps the simplest again unable only in strong signals and is illustrated in Figure 1.

---Fig. 1---

A piece of wire for an antenna is connected to one side of the diode, the other side of the diode to the earphone—which are by-passed by C—and the other side of the earphones to ground. The efficiency of antennas and ground required will vary with local conditions—depending principally on the strength of the incoming signal.

However, when you get further away from the broadcast transmitter, you find you need more over-all efficiency than the best ground and antenna alone can give. Thus the next step is to employ a tuned circuit, as in Figure 2. In this circuit, L and C are tuned to the frequency of the station desired—and it still must be a pretty strong station to hear.

From this point on the experimenter can branch out into countless forms of antennas, grounds, and tuned circuits.

For instance, Don Mongard, W2KUJ—designer of the Signal Slicer, the SSJ Jr., and other pieces of somewhat more complicated gear that have been described in past issues of G-E, HAM NEWS—relates considerable success many years ago with an arrangement like that shown in Figure 3. Continued on page 6.
WHERE $L = \text{inductance of a coil}$

$L = LN_2$; $N =$

$L_0 = 1$

$W = \frac{\text{winding width}}{2}$

$T = \frac{\text{winding thickness}}{2}$

$N = \frac{\text{number of turns}}{\text{inch}}$
The accompanying chart shows inductance of coils wound one-turn-per-inch. To find the inductance of a multiturn coil of the same dimensions, use

\[ L = L_0 N^2 \]

where \( L \) is the unknown inductance and \( N \) is the turns-per-inch of the coil in question.

Example: You have a 60-turn coil 3 inches long and 1.5 inches in diameter and wish to know the inductance. The turns-per-inch, \( N \), is 20; and from the chart you determine \( L_0 \) is 0.14. Substituting in the above,

\[ L = 0.14 \times 20^2 = 0.14 \times 400 = 56 \text{ ph} \]

Similarly, to find the number of turns necessary to arrive at a desired inductance with a coil of specified length and diameter, use

\[ N = \sqrt{\frac{L}{L_0}} \]

Example: You have a 7-inch diameter coil form with space for 2 inches long and want to know how many turns are required to obtain an inductance of 30 microhenries. From the chart, \( L_0 \) is 0.04.

Substituting in the above formula,

\[ N = \sqrt{\frac{30}{0.04}} = \sqrt{750} \approx 27.01 \text{ turns-per-inch} \]

Total turns for a 2-inch coil, then, will be 54.

In addition, the formula

\[ L = \frac{L_0 \pi D}{2} \]

can be used to determine either length or diameter, or both, when using a ribbed coil with a fixed number of turns-per-inch.

Example: You have a ribbed form 2.5 inches in diameter which calls for 7 turns-per-inch, and you want to wind a coil with 10 microhenries inductance. Substituting in the above formula,

\[ 10 = \frac{0.04 \pi \times 2.5}{2} \]

is simplified to

\[ 0.2 = \frac{0.2}{2} \]

On the chart follow the 0.2 horizontal axis out to where it intersects the 2.5 inch diameter curve. From this point, drop down the vertical axis and read the length of winding required—in this case, 2 inches. (This same procedure can be used when double- or triple-spacing a winding on a ribbed form. In the case in point, double-spacing would dictate use of 3.5 for \( N \), and triple-spacing 1.75 for \( N \).)
This simple crystal set was built and used in Texas— and it brought in KDKA from Pittsburgh, WOR from New York, and many stations in between. Let's take a closer look at it.

In the first place, the antenna was about 180 feet long. It was No. 30 wire—to conceal from the rooming-house landlord the fact that a radio was in the house. (This idea also worked! Some time later, I found the wall plate and the coupling between them afforded a total of three tuning controls. Now I had a simple way to tune my crystal BC set with one tuning knob—but much more effective. Both the series-tuned circuit of L, C, and F, and the parallel-tuned circuit of Lc and Cc must be tuned to the desired frequency, and the coupling between the coils must be correct. Varying this coupling can change the tuning of the resonant circuits, of course, and this is what complicates matters a bit in tuning such an arrangement.

To return, for a moment, to the subjects of grounds and antennas. The average house contains quite a few possibilities. Another G-E ham—Bill Cofer, W2ZHI—found a few loops of wire around a window frame pretty effective. Another G-E here—who in this instance prefers to remain unseen—suggested that as long as the telephone wires weren’t working and it was a real tough emergency the telephone line would make a nice antenna. He also commented that your body—floating with RF of indeterminate phase—often does quite well as a sky hook.

Another G-E ham found the best ground at his house is the kitchen sink drain pipe. The sink empties into a dry well through a forty-foot 2-inch pipe buried about two feet underground. For some reason this pipe surpasses the well, the water pipes and the drain to the septic tank.

**How about Components?**

Figure 4 shows a fairly efficient little BC receiver made with W2ZHY with the relatively new “loopstick” type antenna. (The circuit is the same as Figure 2.) The broadcast band can be tuned by sliding the ferrite slug in and out. Although the slug in this particular loopstick is designed to be cemented permanently in place, a simple method of arranging for tuning is to cement a matchstick into the hollow core of the slug, then cement a soft rubber washer into the top end of the matchstick to form a coupling between the loopstick and the matchstick. The coil is tuned with a 330 microfarad ceramic capacitor. A mini trimmer could be used to band-set the receiver with a variety of antennas.

The photo tips are held by clips pulled from an old telephone book. One clip is soldered to one of the loopstick terminals; the other is forced in between the loopstick coil form and a paper-insulating ring containing the capacitor. The single earphone illustrated is an inexpensive (4c) India-made affair purchased at Allied Radio in Chicago. The entire receiver can be housed in the cardboard box the loopstick came in, in the pill box or any other convenient nonmetallic container.

A debon air—troublesome—worked out by W2GYY. is shown in Figure 5. This employs the common coil and capacitor found in old broadcast receivers. Only one section of the capacitor is used to tune the broadcast band. The circuit is shown in Figure 6. The 50-micro-
It never fails to happen! Just when you want every- thing working in apple-pie order, things start going haywire. Our editor reports this one. He recently planned to entertain VE3BY at his shack. Earlier that day he threw the switches on his SSB rig—and nothing! No output from his Model 11A exciter. After a lot of hair-tearing, poking, and so on he gave up and hauled the exciter over to W1KUJ's lab.

W1KUJ turned the rig on and lo and behold it worked fine. They went through it with a fine-tooth comb and found nothing wrong. Back to WZ3BY again, and it still worked fine. The only explanation any of us have been able to offer is that bouncing it over the rocky road from Scotia to the G.E. Research Laboratory shook out a gremlin or two.

However, the real bonker is that 75 turned out to be so snifty that night the boys considered themselves lucky to make the one QSO they did—W4GE in Kansas.

We'll admit that with all the provision test equip- ment available in these parts, one of our own mainte- nance procedures—after checking power lines, tubes and connections—is a healthy, walk-in with a baseball bat. We've been known to pull, push, and pull again and often fixes intermittent shorts and open con- nections. But, alas, the cure is nonpermanent.

One of our G.E. hams—WFIYV—had a hand in developing Alkanex, the new wire insulation you may have heard about. Alkanex can be used safely at much higher temperatures than even G.E.'s famous Formex.* In experiments, Alkanex has been baked for six months at 300 degrees F with no sign of deterioration or loss of insulating strength.

The polling, bending and flexing of wire during con- struction of transformers and motors and winding coils puts a severe strain on the insulating enamel. And as you know, proper operation demands that the insula- tion not be broken. In experiments with Alkanex enamel, the coated wire has been pounded flat without breaking the insulating film.

The lines which not so long ago sharply separated the SSB ops from the AM lads are getting pretty blurred these days. Our mail and reports on the sales

of commercially-made SSB equipment tell us that SSB now is considered a "normal" means of communica- tion by the ham fraternity generally. Our editor confirms this, too, because he operates SSB and tells us the phrase "I just got on SSB" is cropping up pretty regularly in the round tables.

The editor also reports that the boys are using about every tube in the book for linear amplifiers. That reminds us that until a very short time ago we were continually flooded with requests for linear operating data on various tubes. These requests have dwindled to a mere trickle. And that, we feel, is a healthy sign. In true amateur spirit, the boys are trying all kinds of tricks with all kinds of tubes.

Time was when our Power Peaker and Linear Line- ar was standards (and we still think the E1A is hard to beat for watts-per-dollar!) In fact, not long ago we at G.E. constituted a pretty large percentage of amateur SSB operations. Now, with the influx of hundreds more SSB stations—thousands for all I know—we at G.E. take pride in the fact that although we have been relegated to a pretty tiny percentage of the total SSB group here and there, the G.E. Amateur Radio NEWS helped make SSB practical for the average ham.

We still expect to see articles on SSB equipment. But we are quite frank to admit that a greater amount of valuable work is being done by the individual hams themselves. In short, we succumb to sheer force of numbers.

Here at G.E. we say "Progress is our most important product." And we are humbly appreciative of the fact that we have had the opportunity to promote amateur progress by pioneering in SSB.

The Rochester, N.Y., Amateur Radio Association has set up "Operation Aid"—a ten-man committee dedicated to helping the disabled, sick or hospitalized hams get on the air. They service any ham—"RAA" member or not—reports the club bulletin, RARA Rag.

RAA Rag also say: "One hand in pokey, no get shakey."
A new G-E beam pentode miniature of possible interest to amateurs in 110-volt plate voltage applications is the 6CA5. Designed primarily for use in audio-frequency power output stages, the tube features high power sensitivity at relatively low plate and screen voltages. Maximum plate dissipation is 5 watts.

**GENERAL**
- **Heater Voltage, AC or DC:** 6.3 Volts
- **Heater Current:** 1.2 Amp
- **Direct Inter electrode Capacitances (approx.):**
  - Grid 1 to Plate: 0.5 µuf
  - Screen to Plate: 1.4 Watts
- **Heater-Cathode Voltage:**
- **Heater Positive with Respect to Cathode:**
  - DC Component: 100 Volts
  - Total DC and Peak: 300 Volts
  - Heater Negative with Respect to Cathode:
  - Total DC and Peak: 200 Volts
- **Grid 1 Circuit Resistance:**
  - With Plate Bias: 1.1 Meg
  - With Cathode Bias: 0.5 Meg
- **Bulb Temperature at Hottest Point:** 180 C

**MAXIMUM RATINGS—DESIGN CENTER VALUES**
- **Plate Voltage:** 110 125 Volts
- **Screen Voltage:** 110 125 Volts
- **Peak AF Grid 1 Voltage:** 4.0 4.5 Volts
- **Screen Voltage:** 130 Volts
- **Grid 1 Voltage:** 16000 15000 Chmas
- **Transconductance:** 8100 9200 mhos
- **Zero-Signal Plate Current** (approx.)
  - Max. Signal Plate Current: 32 37 ma
- **Zero-Signal Screen Current** (approx.)
  - Max. Signal Screen Current: 3.5 4.0 ma
- **Load Resistance:** 3500 4500 Chmas
- **Total Harmonic Distortion** (approx.)
  - Max.—Signal Power Output: 5 6 Percent

**TYPICAL OPERATION—CLASS A**
- **Plate Voltage:** 118 125 Volts
- **Screen Voltage:** 119 125 Volts
- **Grid 1 Voltage:** 4.5 4.5 Volts
- **Plate Resistance (approx.):** 16000 15000 Chmas
- **Screen Dissipation:** 1.4 Watts
- **Transconductance:** 8100 9200 mhos
- **Zero-Signal Plate Current** (approx.)
  - Max. Signal Plate Current: 32 37 ma
- **Zero-Signal Screen Current** (approx.)
  - Max. Signal Screen Current: 3.5 4.0 ma
- **Load Resistance:** 3500 4500 Chmas
- **Total Harmonic Distortion** (approx.)
  - Max.—Signal Power Output: 5 6 Percent
  
**Heater-Cathode Voltage**
- **Heater Positive with Respect to Cathode:**
  - DC Component: 100 Volts
  - Total DC and Peak: 300 Volts
- **Heater Negative with Respect to Cathode**:
  - Total DC and Peak: 200 Volts
- **Grid 1 Circuit Resistance**
  - With Plate Bias: 1.1 Meg
  - With Cathode Bias: 0.5 Meg
- **Bulb Temperature at Hottest Point:** 180 C

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