Electronic TUBES

TUBE DEPARTMENT
GENERAL ELECTRIC
Schenectady 5, N. Y.

G-E HAM NEWS

JANUARY–FEBRUARY, 1955 VOL. 10–NO. 1

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"

CONTENTS

OPERATION CRYSTAL

it can happen here . . .

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 ham 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.

—*Lighthouse Larry*

The basic component in a simple radio detector is a rectifier to peel 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 some other kind can serve the same rectifying purpose. The rust or corrosion creates a "semi-conductor"—passing RF current in one direction.

Every once in a while one finds an audio-resonant system attached to the corroded metal—like, for instance, a bathtub of proper dimensions with rusty pipes—and lo and behold, we actually have a "singing bathtub." This phenomenon is, of course, the basis for the oft-told tales in ham circles about the old lady next door complaining she can hear your voice CQ'ing in the gold in 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.

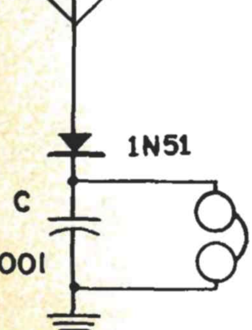


Fig. 1

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, we suggest the crystal diode. And this can be hooked up in a variety of ways. Perhaps the simplest—again usable only in strong signal areas—is illustrated in Figure 1.

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

However, when you get farther away from the broadcast transmitter, you find the need for 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

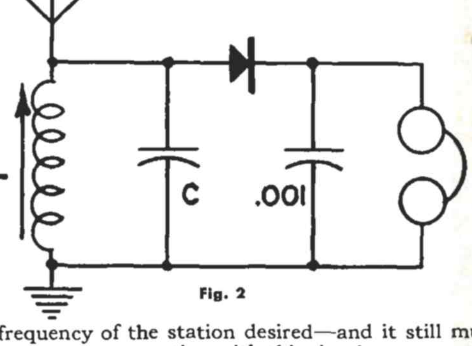


Fig. 2

the frequency of the station desired—and it still must be a pretty strong station with this simple setup.

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

For instance, Don Norgaard, W2KUJ—designer of the Signal Slicer, the SSB Jr. and other pieces of somewhat more complicated gear that have been described in past issues of G-E HAM NEWS—recalls considerable success many years ago with an arrangement like that shown in Figure 3.

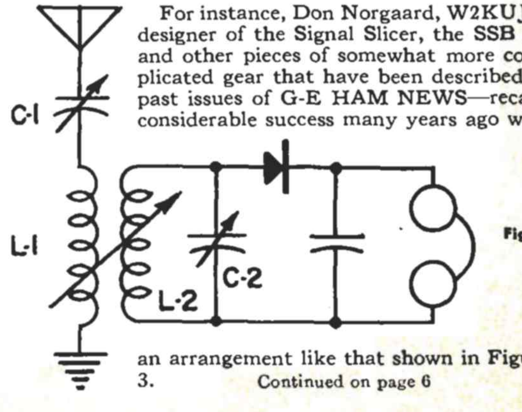
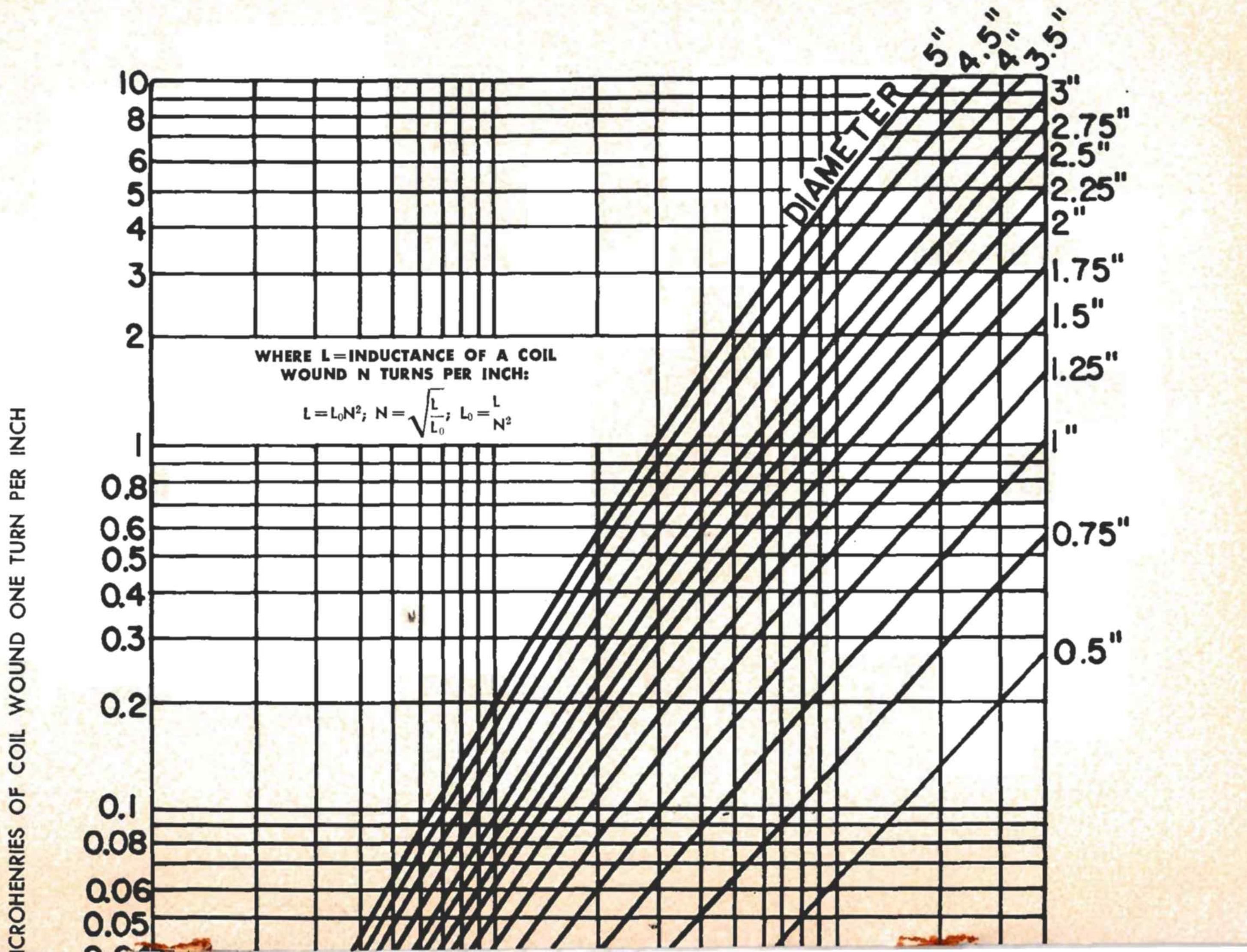
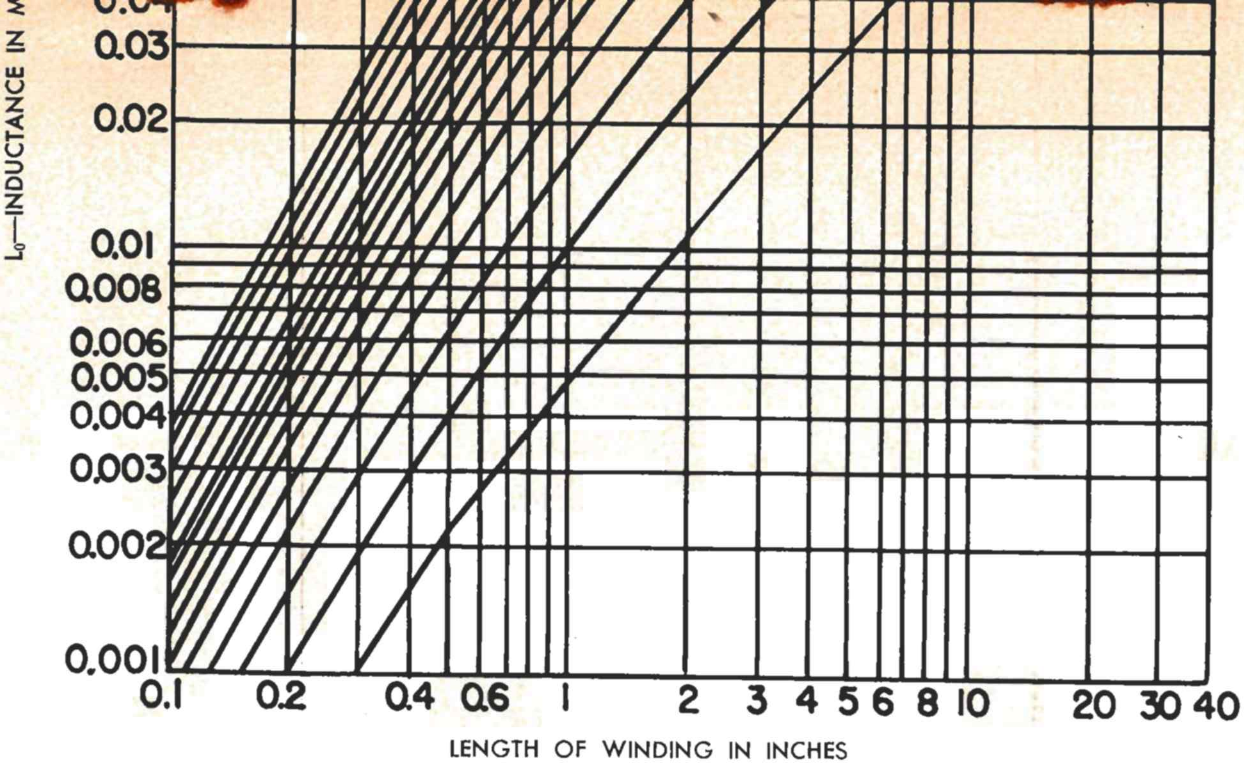


Fig. 3

Continued on page 6

COIL INDUCTANCE CALCULATOR





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. (Note—N is *not* the total number of turns on the coil!)

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,

$$L = 0.14 \times 20^2 = 0.14 \times 400 = 56\ \mu h$$

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 1-inch diameter coil form with space for a winding 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,

$$N = \sqrt{\frac{30}{.04}} = \sqrt{750} = 27.01 \text{ turns-per-inch}$$

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

In addition, the formula

$$L_0 = \frac{L}{N^2}$$

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,

$$L_0 = \frac{10}{7^2} = \frac{10}{49} = 0.2.$$

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, KFI from Los Angeles, 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.

Note, also, that two tuned circuits plus the coupling between them afforded a total of three tuning controls. Not quite as simple an affair to tune as today's BC set with its one tuning knob—but much more effective. Both the series-tuned circuit of L_1 and C_1 and the parallel-tuned circuit of L_2 and C_2 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 home contains quite a few possibilities. Another G-E ham—Bill Coffey, W2ZHI—found a few loops of wire strung around a window frame pretty effective. Another OM here—who in this instance prefers to remain unnamed—suggested that as long as the telephones 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 by W2ZBY with the relatively new "loopstick"

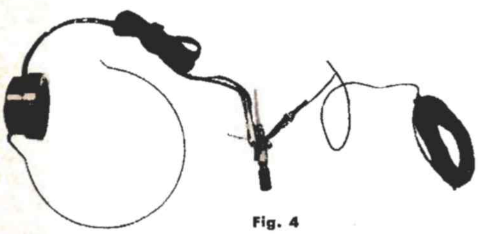


Fig. 4

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 loopstick coil form to act as friction-type holder for the matchstick. The coil is tuned with a 330 micromicrofarad ceramic capacitor. A mica trimmer could be used to band-set the receiver with a variety of antennas.

The phone tips are held by clips pulled from an old tube socket. One clip is soldered to one of the loopstick terminals; the other is forced in between the loopstick coil form and a paper-insulation ring that comes on the loopstick. The single earphone illustrated is an inexpensive (96¢) 1000-ohm affair purchased from Allied Radio in Chicago. The entire receiver can be housed in the cardboard box the loopstick comes in, a plastic pill box or any other convenient nonmetallic container.

A deluxe arrangement—worked out by W2GYV—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-

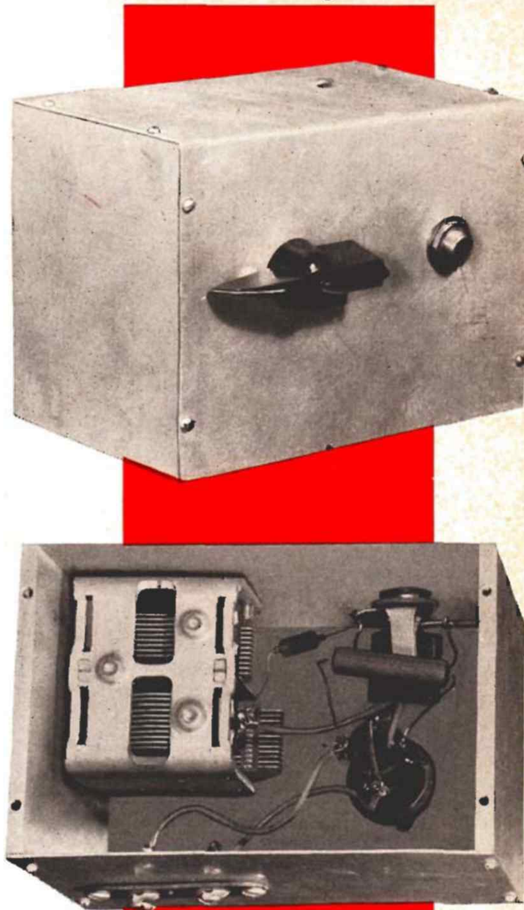


Fig. 5

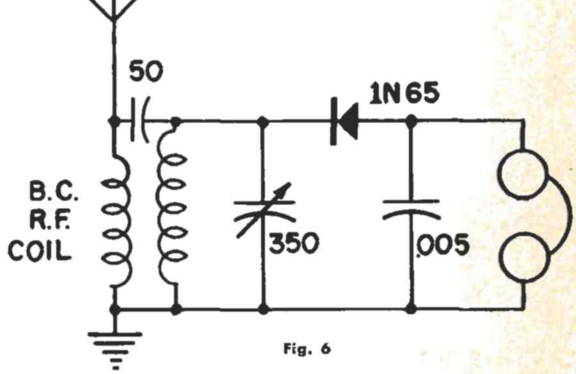


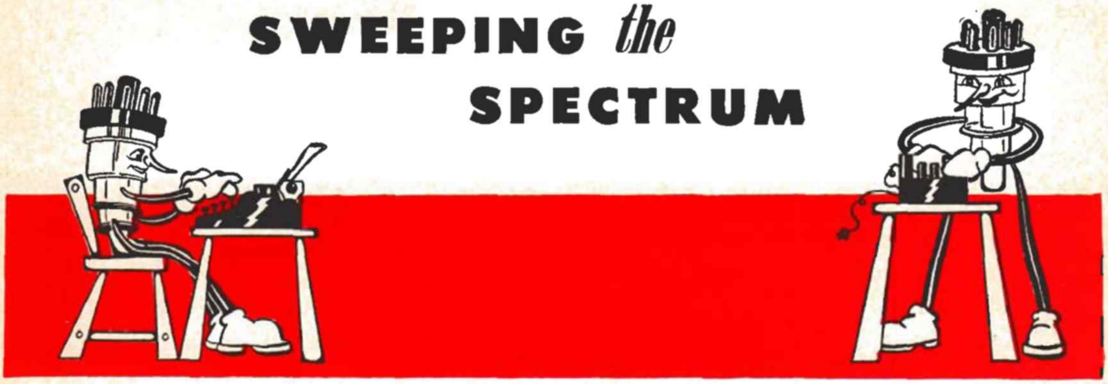
Fig. 6

microfarad capacitor provides additional coupling. Other arrangements may work better in other locations.

We've thought of installing a diode detector in an empty "can" on one side of a head set, in a hat, and in an empty wristwatch case—comic strip style.

Any more ideas?

SWEEPING *the* SPECTRUM



It never fails to happen! Just when you want everything working in apple-pie order, things start going haywire. Our editor reports this one. He recently planned to entertain VE3BV at his shack. Earlier that day he threw the switches on his SSB rig—and nothing! No output from his Model 10A exciter. After a lot of hair-tearing, poking, and so on he gave up and hauled the exciter over to W2KUJ's lab.

W2KUJ 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 W2ZBY 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 hooker is that 75 turned out to be so stinko that night the boys considered themselves lucky to make the one QSO they did—WϕGK in Kansas.

We'll admit that with all the precision test equipment available in these parts, one of our own maintenance procedures—after checking power lines, tubes and connections—is a healthy wallop with a baseball bat. This dislodges dust, solder particles, loose nuts and often fixes intermittent shorts and open connections. But, alas, the cure is not permanent.

One of our G-E hams—W2YIV—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 signs of deterioration or loss of insulating strength.

The pulling, bending and flexing of wire during construction of transformers and motors and winding coils puts a severe strain on the insulating enamel. And as you know, proper operation demands that the insulation 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 communication by the ham fraternity generally. Our editor confirms this, too, because he operates SSB and tells me 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 Lazy Linear were standards (and we still think the 811A 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 SSB world, our early articles in G-E HAM NEWS helped make SSB practical for the average ham.

We still expect to run 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—RARA member or not—reports the club bulletin, RARA Rag.

⁂ ⁂ ⁂

RARA Rag also say: "One hand in pockey, no get shockey."

—Lighthouse Larry

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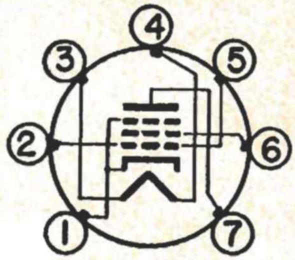
* See G-E HAM NEWS, Vol. 8–No. 5.

Technical Information

6CA5

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 Interelectrode Capacitances (approx.)	
Grid 1 to Plate	0.5 $\mu\mu$f
Input	15 $\mu\mu$f
Output	9 $\mu\mu$f

MAXIMUM RATINGS—DESIGN CENTER VALUES

Plate Voltage	130 Volts
Screen Voltage	130 Volts
Positive DC Grid 1 Voltage	0 Volts
Plate Dissipation	5.0 Watts
Screen Dissipation	1.4 Watts
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	
DC Component	100 Volts
Total DC and Peak	200 Volts
Heater Negative with Respect to Cathode	
Total DC and Peak	200 Volts
Grid 1 Circuit Resistance	
With Fixed Bias	0.1 Meg
With Cathode Bias	0.5 Meg
Bulb Temperature at Hottest Point	180 C

TYPICAL OPERATION—CLASS A_1

Plate Voltage	110	125 Volts
Screen Voltage	110	125 Volts
Grid 1 Voltage	−4.0	−4.5 Volts
Peak AF Grid 1 Voltage	4.0	4.5 Volts
Plate Resistance (approx.)	16000	15000 Ohms
Transconductance	8100	9200 μmhos
Zero-Signal Plate Current	32	37 ma
Max.-Signal Plate Current (approx.)	31	36 ma
Zero-Signal Screen Current	3.5	4.0 ma
Max.-Signal Screen Current (approx.)	7.5	11 ma
Load Resistance	3500	4500 Ohms
Total Harmonic Distortion (approx.)	5	6 Percent
Max.—Signal Power Output	1.1	1.5 Watts

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