Electrical Interference

BY W. R. NELSON,* WA6FQG

In Two Parts

Part II — Tracking and Cure

Part I, in April *QST*, told you how to spot the various types of electrical noise associated with power lines and the operation of electrical equipment. This concluding section describes tracking techniques that have proved to be effective, and suggests methods of suppressing interference from common sources of noise.

THE similarity of the interference problems afflicting the power company and the amateur, the sources of electrical interference, the frequencies affected, and the characteristics of interference were covered in Part I of this article. How to locate a source of interference and the approach to use when it is located will be covered in this Part.

The patience of Job and qualifications of a top-notch diplomat are the requisites for locating and correcting consumer-created interference. To illustrate the need of patience, an interference affecting 6 and 2 meters as well as TV in a one-block area was clocked for a period of 25 seconds on and 35 seconds off. The interference was not on each day and not prevalent for 24 hours a day, but it had to be some sort of timing device. Twenty-five seconds is not ample time to locate the source of interference easily. The approach to this problem is similar to the children's game "Red Light-Green Light," and when the noise stopped you stopped. Visualize a grown man walking down the street for 25 seconds and stopping for 35 seconds! After the offending house was located it was still difficult to pinpoint the source, but eventually the device turned out to be an old electric clock on the mantle. The interference occurred when the second hand was on its upward travel between 35 and 60 seconds, but as the lady of the house was a fastidious housekeeper and dusted the house every day, when the clock was disturbed the interference would stop for a period of a few hours.

The degree of difficulty in locating interference will depend on the frequency affected. If a noise is heard on 40 and 75 meters and no higher, expect the source to be a considerable distance from you. However, it could be a fluorescent light near you.

When trying to locate interference, first listen to its characteristics to determine the pattern, and consider the weather conditions. Does the noise sound the same on all frequencies or is one noise covering another? How high can this interference be taken in frequency? Does it affect the TV set? What does it look like on the scope? These questions must be answered before you start. *Caution:* Remember frequency and distance — low frequency is far and high frequency is near.

Let us assume that you have a problem of interference — a simple one, to start with. It has the characteristics of a thermostatically controlled device — buzzt — buzzt — buzzt. You can detect this noise on all ham bands and it is noticeable on the TV set as a band of "shot" lines across the picture tube, with the same sequence as that heard on your ham receiver.

Check at Home First!

To avoid later embarrassment you must check your own QTH. Recently a ham complained that he was having intermittent noise problems. He wrote a letter blaming the power company for all of his interference — and investigation revealed it to be the aquarium heater in his own house. Using a portable receiver, battery-operated, tune off a station to where you can hear the interference, and then take the receiver with you to your circuit-breaker or fuse panel and de-

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The author in the special car fitted out by the Southern California Edison Company for hunting sources of radio noise. Complete receiving coverage from the broadcast band through 2 meters, plus ham-band transmitters, makes this a really complete mobile station.

energize each circuit in your house. If the noise is still noticeable you can be certain the source is not in your QTH.

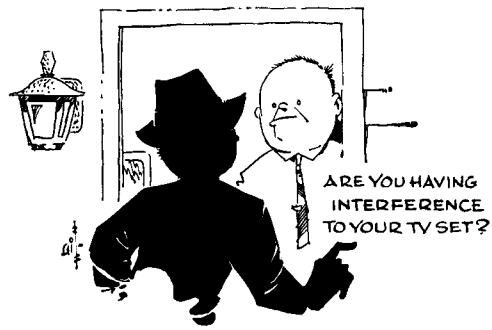
Zeroing In

It will be assumed that you have a mobile rig or that a friend has one available, because you are going on a hidden transmitter hunt. Tune the receiver to the highest frequency at which you can hear the interference. Back off on the r.f. gain control until you can just hear the noise and start driving down the street. If the noise drops out you are going in the wrong direction; turn around — *safely* — and head in the other direction. You will notice that the level is building up as you approach the source. Back off again on the r.f. gain and keep going until you again lose the noise. Turn around and retrace your path, again checking the level. Check the suspected area several times while mobiling; you will be within two or three houses of the source.

Using the portable radio, walk up and down the street until you are positive which house is creating the interference. It may also be necessary to walk into a few driveways before being certain of the location.

How to Influence People

Now what are you going to do? Tell the people that they are interfering with your ham receiver? Are you as sure of the location of the source as they have been when accusing you of TVI? Being a diplomatic ham operator you know that your motto of "Don't do unto others as others have done unto you" must be followed. As soon as that door opens you know you are going to say cheerfully, "Hello, I'm Mr. Jones, the ham operator that lives down the street, and I was wondering if you are having interference to your TV set." Right then you have proved that you were not creating the interference. Ask him if you may come in and check to see if it is the same as you see on your own TV set — and it will be. If the source is in this particular house the interference will be more severe and you will undoubtedly be asked where the interference is coming from. Could it be the power lines? You, of course, can tell him now that only a small percentage of interference comes from power lines.



Tune your receiver so the noise can be heard and show him that it is the same as seen on the TV screen. Tell him that in order to locate the source of interference it will be necessary to go through a process of elimination. Ask him if he would, with your assistance, turn off his circuit breakers one at a time to make sure that his house is not the source of the interference. Let us assume again, to make things more difficult, that his house was *not* the source. You have established good public relations with your neighbors because, when the source finally is found by continuing the same approach, you will go back and tell him the area is now clean. He will express his gratitude for the assistance, and is sure to tell his neighbors of your efforts in eliminating interference. You will not tell him the location of the source. This is your secret as well as the secret of the person with the offending device.

When you located the source you did not tell the individual he was creating interference to the whole neighborhood. You merely asked that he have the device corrected, which he undoubtedly will do. Never suggest that you might go to the FCC. If need be, tell him he is transmitting illegally without an FCC license and the application of a filter will eliminate the noise. In the domestic and commercial fields, capacitor manufacturers have placed filters on the market for practically every type of interference-producing device.

Most individuals will cooperate if the approach is right although, of course, occasionally there are those who do not wish to cooperate. Such an individual was found by one ham operator who determined that the interference bothering him was a fluorescent light. He traced it as described above and found it to be a defective fluorescent light in his neighbor's garage. The neighbor told him the light wasn't bothering him as he never listened to a radio, so he could see no reason for changing it. There was only one thing for the ham to do: He purchased a new light for his neighbor and hasn't been bothered since.

You feel a sense of accomplishment when you help your neighbors and yourself. You have

graduated from the kindergarten class of interference location, and naturally you tell your ham friends.

A Harder Case

One evening you receive a call from one of your buddies. He tells you he has a noise starting at approximately 9 A.M. and stopping at approximately 12 midnight, consequently wiping him out on 40 and 75 meters. He asks you to bring the mobile rig for the purpose of locating the source. Because, like a Boy Scout, an amateur is helpful, you agree. The noise you hear on h's receiver sounds very much like a spark discharge. There is a frying and buzzing sound together with intermittent popping. You also note this noise cannot be heard any higher than 40 meters, and there is a characteristic pattern: the noise lasts for approximately 15 minutes and gradually attenuates, followed by the popping, which lasts for a minute or two. The popping sounds become more frequent, building up to the frying or buzzing sound.

Although you are able to hear the noise on your mobile receiver at 40 meters you notice it has a lower level of intensity. This could be because the fixed-station antenna has more gain, or because the noise is being conducted by communication circuits and power lines. As you leave his QTH you observe a slow rise and fall in intensity. These are standing waves, similar to regular fading on a signal. As you proceed you note the standing waves are getting closer together and the intensity of the noise is increasing. Tune to a higher frequency and continue driving.

When dealing with an interference affecting the lower frequencies you will undoubtedly hear other noises. These noises tend to throw you off course, and in some cases it will be necessary to return to your starting point. It is very important that you memorize the sound of the noise you are tracing.

A source of interference will set many traps. As you near the source you will note very high peaks at changes of directions of the circuits and lines on the poles and at transformer locations. You may feel that you have located the source at these particular locations because of the peaks. These are false. In all cases of tracing interference, drive on past the peak. Many complaints have been received blaming a leaky transformer on a pole. The much maligned "leaky transformer" is almost purely mythical, since the usual oil-filled distribution transformer is one of the most trouble-free pieces of equipment on the power system, as far as being a source of interference is concerned.

You have ignored the false peaks and are now able to hear the noise in your 6-meter converter, indicating that you are close to the source. You pin the source down as shown in the previous example. What did you find this time? A color TV set. There was an arc in the cap of the high-voltage tube; the owner of the TV set says they turn it on at 9 A.M. and off at midnight.

Handling Power-Line Noise

When dealing with suspected power-line interference the method of locating the source is the same as described above. It is very helpful if you give the power company the general location of the source definitely responsible for the interference. In all cases of suspected power-line interference, leave the final determination of the location to the power-company interference investigator. Under no circumstances should you shake a guy wire or hammer a pole, as there is

Sources	*Remedial Measures*
Belt static	Bond machines together and to ground. Apply graphite-type belt dressing to belt.
Commutator-type motors	Turn down commutator, seat brushes, filter at motor with effective grounding.
Oil-burner and ignition-type industrial equipment	Heavy-duty spark plug suppressors, line filter near unit. Bond motor, burner unit, and furnace to an effective ground.
Electric shaver	Ceramic capacitor-type filter built into shaver.
Neon signs	Insulate thoroughly, replace defective tubes. Bond isolated conductive material in field of sign.
R.F. heating (dielectric and induction type, diathermy, etc.)	Check frequency and harmonics. Unit should be effectively grounded and shielded. Reduce drive in final amplifier to, reduce harmonic output. Install necessary traps and filters.
Oscillating TV booster (v.h.f.)	Redress input and output leads, check neutralization, provide more adequate shielding. Install switch to de-energize v.h.f. booster when u.h.f. channels are received.
Garage-door opener	Replace superregenerative receiver with nonradiating type.
Thermostatic devices	Filter as close to contacts as possible.

a likelihood of a circuit outage or damage to the pole for which you would be responsible. Using the TV cliche, "Please, amateurs, we'd rather do it ourselves."

Looking for a source of interference is like a transmitter hunt. How many times have you stopped alongside a chain-link fence expecting to find the transmitter tied to the fence? Here again you had the problem of the false peaks. Don't feel bad. A complaint was received from three ham operators who had traced a noise to a transformer. They traced the interference individually, each not telling the others what he had located. When the investigator came on the scene, he located the source three blocks farther away on a street-light mast arm.

Frequency vs. Distance

Interference on the lower frequencies, including broadcast, may be transmitted over a wide area by power lines, telephone lines, metallic, or conductive equipment. The noise may also be transferred from one circuit to another. This condition does not present such a problem on the v.h.f. since practically all v.h.f. radiation is direct. The higher-frequency interference is dissipated by direct radiation within a very short distance of the source on wire circuits. The source may be located quickly using the highest frequency on which the interference is audible and proceeding toward the area of greater intensity, increasing the frequency as necessary to pinpoint the exact offending equipment.

Interference Remedies

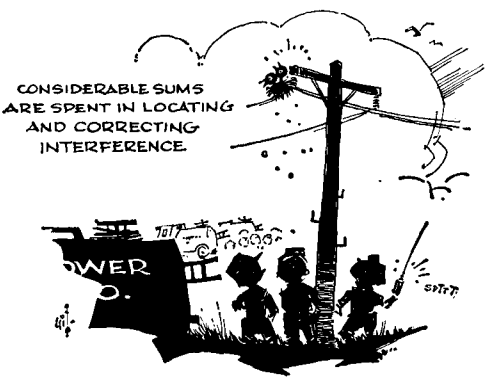
You will be asked what can be done about an offending device. Here are some typical sources and remedial measures.

In general, the largest capacitance readily available, installed as close as possible to the interference source, is the most effective suppressor from a radio interference standpoint. In the case of portable appliances, however, capacitors are limited in size by the requirement that possible current to ground through the capacitor may not exceed 0.3 ma. This requirement is designed to protect the user of the apparatus from appreciable shocks.

What the Amateur Can Do

When you realize that there are 270,000 licensed amateur radio operators in the 50 states it is certain there are many potential interference locaters who could lower the overall level of interference. Here you also have 270,000 amateurs who could improve the image of ham radio by locating and correcting consumer-created interferences. It might take you away from your operating desk where you have been cussing and discussing the interference problem.

It is very easy to take the attitude "let George do it," or "let's let the government set up a minimum level of radiation for all electrical devices and power lines." Who is going to make the checks of the radiation levels? The amateur? If he does, how accurate is his testing equipment? What is the minimum level of radiation permitted? Should the level be the same for the amateur working 2 and 6 meters as for the DX'er working a weak signal? It is well to remember that a high noise level affecting the DX'er would be no problem to the ham working the v.h.f. region and it is very doubtful that government control is the whole answer. Something will still go wrong, even with the quality control in all steps of the manufacture of any device. How many times have you purchased an item and had to return it to the dealer for some change? How about the new car? How about that new piece of amateur gear? How far can we go in the quest for a low noise level? Should we insist on the removal of the interference potential of all devices or should we ask that the devices be electromagnetically compatible with communications?



Many investor-owned power companies have a program of locating interference for their customers, whether it is consumer-created or power-lined created. This is a service that started on a voluntary basis. Each year the companies spend considerable money in the location and correction of all types of interference. Each year considerable money is spent by the R & D engineers in the development of interference-free power lines. The power companies feel that they can take care of interference from their power lines on a voluntary basis as a service to their customers, without the necessity for attempting to establish minimum levels of radiation. All it takes is a call to the business office in your area to register a complaint of known power-line interference. Cooperation and patience by all concerned, whether it be TVI or electrical interference problems, is the keyword. QST

Editor's Note: The March 1966 issue of *Edison News*, a publication of the Southern California Edison Company, contains an illustrated article describing the author's activities as the company's Amateur Radio Representative. If you are a power company employee and would like a reprint copy, ARRL Headquarters has a limited supply which will be sent free as long as they last.