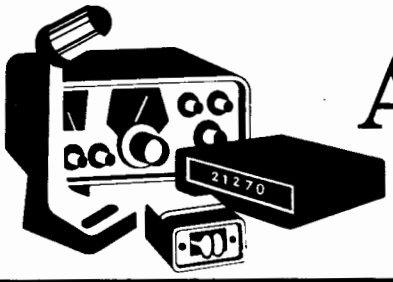

Amateur Radio

By Herbert S. Brier

LIGHTNING AND THE RADIO AMATEUR

MOST OF US are familiar with the indirect effects that lightning produces on amateur communications—tremendous static crashes can make 80 Meters (and above) almost unusable on some summer nights. But every so often, we hear of the direct consequences of a lightning strike at an amateur's station. Among the reported effects are vaporized antenna elements, burned-out rotator motors, melted insulation in control and coaxial cables, and fused conductors.

Inside the shack, a number of things can happen. The antenna coils in the receiver can melt, or the contacts on the band switch weld together. Tubes and transistors can be destroyed. Diodes and capacitors, especially in the power supply, can blow. From the outside, the rotor control box might look fine, but it can be a shambles of burned out and shorted components on the inside. Half the lights in the house might be blown, and the rest will glow whether they are switched on or off. Electrical receptacles can be blown half out of their wall boxes. If a fire ensues, the firemen can do as much damage ripping out equipment and cutting cable as the original lightning strike caused.

This type of damage that has been experienced by amateurs whose antennas were struck by lightning does *not* mean that an outside antenna invites disaster in an electrical storm. On the contrary, a properly installed antenna is said to create a "cone of protection" whose diameter is approximately equal to the height of the antenna itself. Many amateurs have operated for years and years with antennas that are the highest objects in the vicinity of their homes without lightning damage (Fig. 1).

The secret of protecting antennas and the equipment connected to them is to provide a direct path from the antenna to the earth so that the electrical charges picked up from the atmosphere will be discharged harmlessly into the earth, rather than blasting a path to the earth through the equipment to which the antenna is connected. The most familiar static discharge units (popularly called "lightning arrestors") are inserted in the feedlines of TV and radio receiving antennas and are grounded at the point where they enter the building. The units are usually miniature spark gaps. The weak received signals flow past the gap without difficulty, but high-voltage static charges jump the gap and are diverted to the earth. Coaxial units with trade names such as "Blitz Bugs" can be connected in series with a coaxial cable. They are usable in transmitting applications when the SWR on the line is not too high. However, they are not really necessary when a properly-installed coaxial line is used with a dc-grounded antenna. A typical homemade arrestor for open-wire line is shown in Fig. 2.

If coaxial cable is used to feed an antenna, the National Electrical Code's provisions for lightning protection are met by connecting its shield directly to ground where the cable enters the building. One method of doing the job is to mount a type *83-1F* or *UG-363/U* coaxial "bulk adapter" on a corrosion-resistant metal bracket just outside or inside the opening through which the cable comes into the radio room. Connect the coaxial cable from the antenna to one end of the *83-1F* adapter using a PL-259 connector on the cable, and the cable from the transmitter to the other end. Clamp the bracket to a ground electrode through a heavy conductor running in as straight a line as practical.

Ground Conductors. The N.E.C. specifies that a ground conductor must have a minimum cross-sectional area at least as large as *all* conductors being grounded through it. In any event, it should not be smaller than *No. 10* and should be composed of copper, bronze, copper-clad steel, or equivalent. The conductor may be bare or insulated and should be protected from mechanical injury. It should go to the ground electrode in the shortest practical path with no sharp bends. Otherwise, the heavy current flowing through it during a lightning strike may ionize the air at

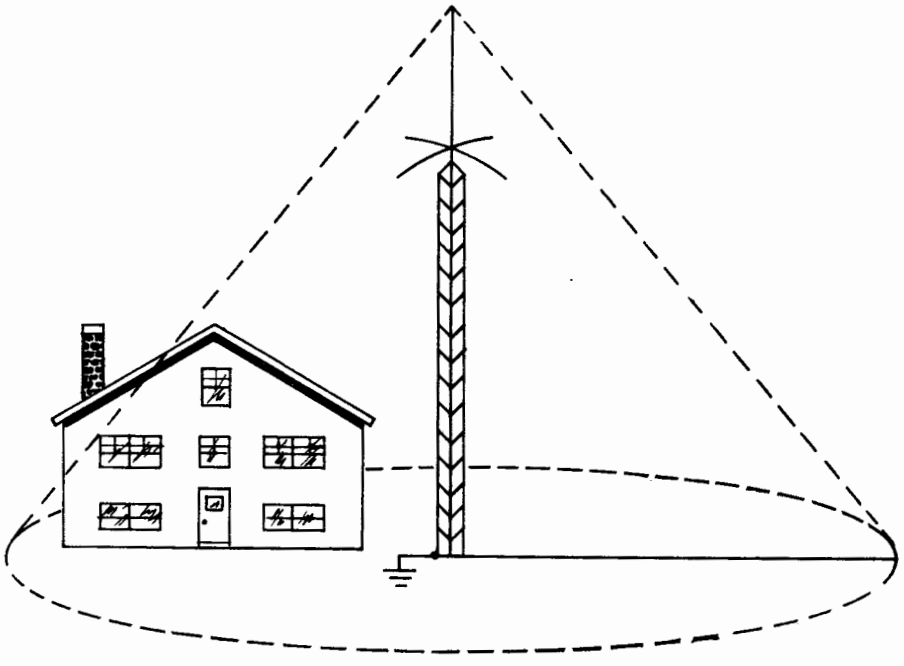

Fig. 1. Grounded antenna and tower create "cone of protection" for nearby structures.

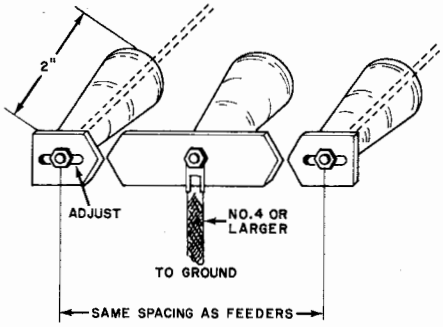

Fig. 2. Spark-gap lightning arrestor for feedline.

the bend and leave the conductor at that point to find its own path to ground, doing much damage in the process.

When available, a metal underground water pipe should always be used as the ground electrode, regardless of its length; however, if its underground section is (or is likely to be) less than 10 feet in length, it should be supplemented by an additional grounding electrode. This electrode can be a heavily galvanized iron or steel pipe a minimum of 1.25 inches, outside diameter, a ½-inch copper rod or other approved ground electrode driven into the ground a minimum of eight feet. Such a driven electrode can replace the buried, water-pipe ground, if the latter is unavailable. If the soil is dry and sandy, two or more driven electrodes spaced a minimum of six feet apart and bonded together can be used to achieve a lower ground resistance. In fact, all available ground electrodes should be bonded together to lower the ground resistance as much as possible.

It's interesting to note the differences in ground systems for lightning protection and a buried radial system for a vertical antenna's ground plane. The former uses electrodes driven or buried deep in the earth; the latter is burned only a few inches. There is no objection to connecting the ends and centers of the radials for additional lightning protection, however.

Ground all supporting structures, including those mounted on roofs of buildings. Metal towers are usually adequately grounded, but run a heavy conductor to the hardware at the top of a wooden structure supporting a horizontal antenna to the ground electrode. If the mast supports only a wire antenna, extend a metal rod a foot or so above its top as a lightning rod. Any elevated "ground plane" radial wires and the shield of the coaxial feed line should be grounded before adjusting the antenna to the desired operating frequency. When the feed point of the vertical radiator is isolated from the radial system, a coaxial static discharge unit ("Blitz Bug") may be inserted between the PL-259 connector and the feed line to help drain static charges off of the vertical radiator of the antenna.

Unfortunately, grounding a multiband "trap" antenna at the feed point does not protect its traps from high-intensity static currents in the event of a strike. The obvious solution to the problem is a spark gap across each trap, adjusted to the minimum spacing that does not arc under normal operation. However, many amateurs would merely repair or replace the trap if it is damaged by lightning.

Inside The Shack. For maximum safety, bond all metal cabinets, microphones, keys, and control boxes to a common ground bus. Homes built in the past few years or so often contain 3-terminal wall outlets with the third (round) terminal connected to the grounded neutral point of the power line. By using appropriate power cords with the third conductors connected to all chassis, they will be automatically grounded as the power plug is inserted in the receptacle.

I wish I could say that these suggestions guarantee that lightning will never damage any of your equipment. The sad truth is that a lightning strike or near miss creates such a high-energy field in the vicinity that induced voltage spikes up to several thousand volts have been measured on local power lines during severe electrical storms. Occasionally, these surges find their way to ground through equipment plugged into the lines, popping components in the process. Cautious operators pull the power plugs and disconnect their antennas whenever a bad storm is brewing, or when they leave their equipment unattended. If you decide to follow their lead, don't just disconnect the antenna lead-in and leave it lying on the floor. Whether connected or disconnected, the only safe conductor in a storm is a grounded conductor. If your antenna selector switch grounds all positions except the one in service, turn the switch to an unused position whenever you leave the room. Finally, don't forget to unplug the rotor control cable and plug it into a socket with all terminals connected to the main ground electrode. ◈