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Installing Lightning Arresters for Equipment Protection

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Statistical data which show that lightning damages more than $100 million worth of equipment and property in the U.S. each year should move us toward precautionary action. All too often, however, we think about installing protective equipment only when we hear those first claps of thunder. While nothing can be done to eliminate lightning, something *can* be done to eliminate the damage that it brings to electrical wiring and electrical equipment. In fact, good protection can be obtained at very low cost.

If we are to know how this protective equipment functions, we must know how lightning itself behaves. Lightning can cause damage through a direct stroke. This usually damages the structure itself. But, this guide will concern itself with a more frequently occurring type of damage—damage to electrical equipment caused by high voltage lightning surges that enter the electrical system by way of the building's electrical service entrance conductors.

When high voltage lightning surges hit local power lines, they can cause a tremendous charge to be placed on the conductors. These excess voltage charges, often several million volts in magnitude, travel in both directions from the point of the strike.

High voltage lightning surges also may be caused by induced lightning strokes resulting from sudden changes in the nature, size and actions of positive and negative charges in clouds, air and surrounding materials. When the positive charges become free to move, they try to unite with negative charges. In so doing, these charges may travel along an electrical conductor at several hundred thousand volts and several hundred amperes. If the building wiring system is protected, the lightning surge is discharged into ground (earth) rather than through the electrical appliances, as shown in Figure 1.

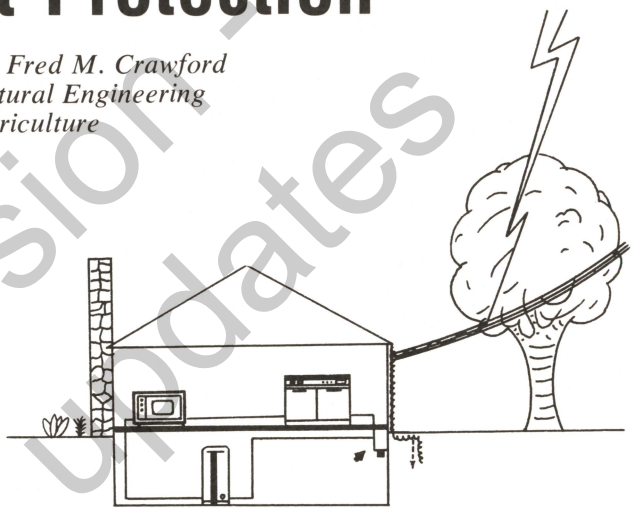

Figure 1. Lightning arresters divert high-voltage surges directly and quickly to ground (earth), protecting electrical equipment.

Lightning Arresters—Function and Type

While improved lightning arresters are relatively new for home and farm building use, similar but larger units have been used successfully by power suppliers for many years. Such units do, of course, protect the power supplier's distribution equipment rather than the consumer's equipment.

Lightning arresters are usually one of two types, the valve type or the expulsion type. While either type is inexpensive to use, each must (1) remove the high voltage charge and conduct it harmlessly to the ground and (2) interrupt the flow of the normal power current which would try to follow this high voltage discharge path.

The valve-type arrester is made up of a tube containing a column of small lead peroxide pellets that are coated with an insulating film or other resistance elements. A sealed dry air gap, in series with the path and formed by such materials, is designed to spark over at a constant voltage value. Its high resistance at circuit voltage and low resistance at high voltage allow these arresters to function many, many times without internal damage.

Another unit, using the expulsion principle, operates in a similar manner. Each acts like a safety valve, automatically draining the high voltage lightning surges into the ground. As the expulsion type contains a fibrous material to disrupt the electric surge and arc, such material may be consumed partially with each use. For this reason, gas evolving arresters are approved by the National Electrical Code for outdoor use only.

Most home lightning arresters are smaller than a baseball and are designed for single-phase 120/240 volt, three wire service with grounded neutral. Properly installed, they provide a lightning discharge path from electric lines to earth, allowing the surge to bypass home wiring and equipment. The effectiveness of the arrester is dependent upon how well the home or farm wiring system is grounded. UMC Guide 1022, "Electrical Grounding for Personal and Equipment Safety," gives detailed information on proper grounding techniques for electrical wiring systems, equipment, tools and wire fences.

Arrester Installation

Lightning arresters should be installed at the point where electrical service wires enter each major building. Figure 2 shows a normal lightning arrester installation. The connecting wires between the arrester and the three service conductors are as short as possible with installation made near the service entrance weatherhead.

Figure 2. Small lightning arresters, installed by a qualified electrician, provide protection against electrical equipment damage.

Lightning arresters should be installed ahead of specialized electrical loads like submersible water pumps, high feed handling, or other equipment that might be located away from, or outside of, arrester protected buildings. When such remotely located equipment is served with underground electrical cables, the arrester can be placed on the fuse box or service entrance box as shown in Figure 3.

Two sections of the 1978 National Electrical Code specifically relate to lightning arrester installation. These are repeated below for the benefit of property owner and contractor.

Section 250-131. Services of Less than 1000 Volts.

Where a lightning arrester is installed on a service of less than 1000 volts, the connecting conductors shall be as short and straight as practicable and of copper not smaller than No. 14 or of equivalent corrosion resistant material. Bends, especially sharp bends, shall be avoided where practicable. The arrester grounding conductor shall be connected to one of the following: (a) the grounded service conductor, (b) the grounding electrode conductor, (c) the grounding electrode for the service, or (d) the equipment grounding terminal in the service equipment.

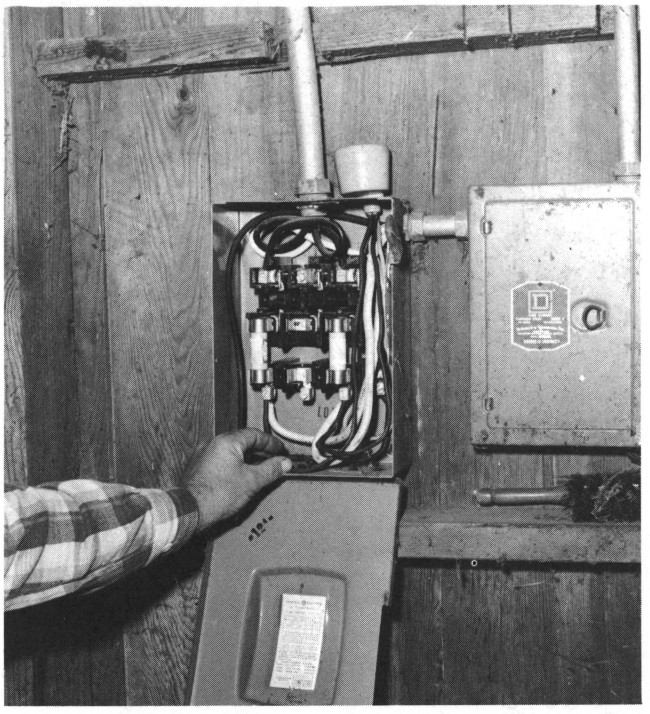

Figure 3. Alternate location for lightning arrester, especially adaptable for remotely located equipment like submersible pumps.

Section 280-32. Arrester Conductors—Size and Material.

The conductor between the arrester and the line wire or bus and between the arrester and the grounding connection shall be: (1) copper wire or cable or the equivalent, (2) not smaller than No. 6, except as provided for services in Section 250-131 for services of less than 1,000 volts, and (3) as short and straight as practicable, avoiding unnecessary bends and especially sharp bends and turns.

Home Owner Benefits

Many case histories have demonstrated the effectiveness of the home or farm lightning arrester. Properly installed lightning arresters, installed with good grounds, will greatly reduce chances of lightning damage to such major electrical appliances as television sets, automatic washers, water heaters, submersible pumps, electric motors and electric heating equipment. Reduced problems mean less personal inconvenience, fewer equipment repair bills and, in some cases, lower insurance rates.

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