

Ground Antennas

It has been found by Kiebnitz and many other observers that signals can be effectively received on an antenna consisting of a single long wire on, or a short distance under the Surface of the ground. This is called a ground antenna. It operates more effectively when the soil is wet rather than dry, and with an insulated rather than a bare wire. It can also be used under the surface of either fresh or salt water. In salt water it should be submerged only a short distance below the surface. The best results are usually obtained with wires well insulated with moisture-proof material.

It seems on first consideration contrary to the usual explanations of radio reception that an antenna extended in a horizontal direction and on or under the ground should be acted upon by a radio wave. The explanation is, first, the wave front of an advancing radio wave is tilted, the amount of this tilt probably being greater just at the surface of the ground than at higher points; and, second, the waves penetrate the ground to some extent, the amount of penetration depending upon the wave length and character of the ground.

The amount of power received by a ground antenna is considerably less than that received by the usual elevated antenna. It is usually necessary to use amplifiers (see chapter 6) to get satisfactory signals. The ground antenna, however, has a number of compensating advantages, so that for some kinds of work its use is desirable. It is a directional receiving device, the strongest signals being received when the wire extends along the line of direction of propagation of the waves. It is stated that the ground antenna does not exhibit the usual troubles during local thunderstorms which make an elevated antenna dangerous to the operator. The ground antenna also, as sometimes employed, has a somewhat greater ratio of signal strength to strays than the usual elevated antenna. The use of the ground antenna in combination with a coil antenna has been found to be of considerable assistance in the elimination (*sic*) of interference and strays, since under proper conditions this combination forms a unidirectional receiving system.

Ground antennas have been used in some experiments for transmitting, but there is apparently no advantage in their use for this purpose.

The length of the wire which should be used as the ground antenna depends on the wave length of the signals to be received. Thus for long wave lengths longer wires should be used than for short wave lengths. The length of the ground antenna or underwater antenna which should be used for the reception of a particular wave length depends on the diameter of the conductor itself and also on the nature of the dielectric material adjacent to the conductor. That is, the best working wave length of a given wire depends on the kind of insulation used on the wire, whether the wire is in earth or in water, and if in earth whether the earth is dry or moist. It has been stated that the best working wave length of a ground antenna is inversely proportional to the capacity of the wire to ground per unit length of the wire. That is, with a given size of wire, the thicker the insulation the longer the most effective wave length, and with a given thickness of insulation, the larger the wires the shorter the most effective working wave length.

If it is desired that a wire buried in the ground should remain in effective operation for more than a few months it is usually necessary to use wire insulated with at least one-fourth inch of good live rubber. Such construction is, of course, expensive. For temporary work an insulated wire is sometimes simply laid out on the surface of the ground.

In earth of the average range of moisture content a ground antenna 75 feet long may be expected to give satisfactory reception from about 150 to 500 meters. For the reception of long waves, as 6,000 meters to 15,000 meters, it may be necessary to use a ground antenna 1,000 or 1,500 feet long. Under average conditions it will be found suitable to use stranded or solid copper conductor, about No. 14 B. & S., with good rubber insulation, buried in a

shallow trench from 6 to 12 inches below the surface of the ground. Under some conditions it may be advisable to bury a wire as deep as 24 inches.

It has been found advantageous to place wires in fairly wet soil or in water, because louder signals will be usually obtained and because the best working wave length of a given wire will remain more nearly constant.

With an underwater wire the signal falls off rapidly with the depth in salt water, but in fresh water wires have been submerged as deep as 60 feet without appreciable decrease of signal.

It should be noted that a ground antenna can not be expected to give good results when used with a crystal detector alone or with a single detector tube, and that for good signals it is usually necessary to use several stages of amplification. (See Sec. 196, p. 479.) At a small receiving station with usual equipment it will usually be found more satisfactory to use the ordinary elevated antenna with good ground connection in preference to a ground antenna.

For further information regarding ground antenna the reader should consult the following papers in the Proceedings of the Institute of Radio Engineers: A. H. Taylor, volume 7, page 337, August, 1919; A. H. Taylor, volume 7, page 559, December, 1919; A. H. Taylor, volume 8, page 171, June, 1920; R. A. Weagant, volume 7, page 207, June, 1919; L. W. Austin, volume 9, page 41, February, 1921.