CHAPTER XV

Advantage of Low Resistance and Stranded Wire

IN a receiving set intended for the reception and accurate selection of distant stations, the importance of good joints should be supplemented by a recognition of the advantages of low resistance. Persistent oscillation is only killed by resistance ; and if a conductor could be used of infinitesimal resistance, extraordinary results could be attained. Some day, perhaps, something could be done in that direction by immersing the set in liquid hydrogen, or even helium ; for at those low temperatures the resistance of metals almost disappears. Conductors become perfect, and oscillations would work up to some approach to an infinite value, even with small stimulus. Such an arrangement could surely never be more than a curiosity, and even as a curiosity it is hardly feasible at present ; but I fully expect that someone will try it in the future.

Meanwhile, we have to do the best we can with ordinary high conductivity copper. Only it must be realized that when working with short waves, and therefore very high frequency,

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the inner part of a wire of any ordinary thickness takes no part in the conduction. The oscillations have not time to soak or sink into the metal, and only the skin or surface contributes to the conduction. In steady currents, every part of the wire conducts equally; the wire acts as a tube acts to water or air, except that in the hydraulic case, surface friction retards the flow a little and leaves the interior of the tube the best and most efficient part. Whereas in the electrical case, conditions are just reversed—the outside of the conductor is the best part; the inner portion is almost useless, except as contributing to mechanical strength.

When a wire is very thin, it may be thought of as all surface. It has no interior. Hence thin wires are more efficient, weight for weight, than thick ones.

The resistance of a thick wire is not much less than that of a thin one to high-frequency currents. At the same time there must be a limit. If a wire is too thin, though the whole of it is effective as a conductor, its resistance is unavoidably high, hence the current is somewhat throttled.

To get over that we use a stranded wire, and the strands must not be in metallic contact, otherwise the interior is obliterated, since it cannot be got at except through metal.

Slight insulation, giving a path between the wires, suffices ; a coat of varnish is enough, a very thin coating of silk is ample. The point is that the strands must of all them be bathed in ether, for it is through the ether that the waves can reach them.

The propulsion of a current in a wire is effected laterally not by end-thrust but by surface propulsion, as for instance when water is propelled in a trough by moving vanes dipping into it. If the trough is completely enclosed, the vanes cannot reach the water. That is like the interior of a thick wire.

It is amazing to how small a depth really rapid oscillations sink into a wire. They sink farther into copper than into iron, for an iron wire has to be magnetized by the interior currents, and this causes so much delay that high-frequency currents keep wholly to a microscopic skin on the surface, and of course the resistance of this thin skin is very high. So, if ever a choke is required to *kill* oscillations, by high resistance, an iron wire is suitable.

For receiving purposes we want the oscillations alive, and not killed. Hence a specially efficient aerial can be made of a great number of insulated stranded wires, even as thin as No. 40.

These remarks apply especially to the leading-in wires. The aerial itself acts partly as a capacity, and for capacity these considerations do not apply; they only apply to resistance for high-frequency currents. Similarly, all high-frequency transformers and the different leads employed should, if perfection is aimed at, be made of fine stranded wire.