CHAPTER XVII

Stray Capacities and Couplings

IT is pretty well recognized now that distributed capacity in a coil, though not wholly avoidable, is undesirable and disadvantageous. Capacity should be defined and localized, and not smeared about along with resistance and inductance. The turns of a coil are intended to act inductively upon one another by magnetic induction.

They do also act on each other by electrostatic induction, which is not wanted. That is what gives distributed capacity; and hence basket-winding and other devices are employed. The separation of the wires diminishes their mutual inductance, which is bad; but it also diminishes their electrostatic or capacity induction, which is good, and the result is a compromise.

But in addition to the recognized coils, there are also capacity and inductive effects between leading-in wires and the ordinary wire connexions. None of these is any good at all, and should be kept to the minimum. We don't want capacity in a leading-in wire, we only want conduction.

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We don't particularly want inductance in a leading-in wire, though we cannot help it; moreover, it does no harm. But what we certainly don't want is mutual induction and capacity between leading-in wires. And these can both be avoided to a great extent. They are no good, and though they do not do very much harm, they are better away.

To avoid them, the wires from different parts of the circuit should not run close together and parallel to each other. If they have to cross, they might cross at right-angles, being well insulated where they cross. Wires which lead to the legs or pins of a transformer or a valve should not be bunched together, even though perfectly insulated from each other. They should be separated. If they can spread out from each other for a little distance, so as not to be even parallel, so much the better. If they are separated by a few inches, their parallel running will not matter. And some careful people attach internal radiating projections to the pinholders of their valves, etc., so that the wires which lead away from the ends of their projections shall not be close together.

These are to some extent counsels of perfection; but wireless receivers are so nearly reaching perfection, and tuning is becoming so

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remarkably accurate, that even these trifles are worth attention. Wires should in fact be not only insulated but isolated. The nearer and more parallel they are to each other, the more they are liable to introduce undesired disturbances and spurious effects. Even insulation is not always attended to as much as it ought to be.

The minor points to be borne in mind in a good wireless set are, then :

Low resistance and perfect joints.

Stranded wire in the high-frequency portions.

Avoidance of stray capacities and mutual inductance.

Keeping away earth-connected surfaces from the immediate neighbourhood of parts in which capacity is not wanted, such as leading-in wires.

Removal of metallic masses, especially copper plates, from the neighbourhood of coils.

And most especially, good joints everywhere, no leakages or bad insulation, and highest conductivity wire.

Referring back to electrostatic induction, masses of metal near coils are apt to prove very troublesome. When a disk of metal is brought near a coil in which are oscillating currents,

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the disk of metal is, of course, a closed circuit, and currents—sometimes called "Foucault currents"—are induced in it. It acts, in fact, like a single-turn coil of very low resistance. And the currents may therefore be fairly strong, so that if the primary coil were conveying strong currents, the disk of metal would get quite hot.

With the kind of currents employed in wireless receivers, there would be no perceptible elevation of temperature unless extremely delicate thermometers were used. But there would be reaction. The disk of metal would be like a secondary coil, and would react on the primary.

Now when coils are thus coupled together, the effect is to diminish the inductance and increase the resistance, and therefore to put the coil out of tune if it forms part of a condenser circuit with free oscillations. The approach of the disk of metal leaves the oscillating circuit no longer free. It is virtually coupled to another circuit, and the disadvantages of reaction set in.

Tuning is not only altered but spoilt, for a double note is generated. As was said in another chapter, it is like coupling two pendulums together, or like a three-legged race.

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But it may be asked : Who brings disks of metal into the neighbourhood of a coil ?

The answer is : You do, if you are using an ordinary adjustable condenser without precautions. An adjustable condenser consists of metal plates, all parallel to each other. And if they are parallel also to the plane of some coil they will react upon it. Possibly they are not very near, in which case the reaction will not be prominent.

But none of such reaction is any use, and whatever there is is bad. What is the remedy ? Either to keep the coils and the condensers far enough apart, or to arrange the plane of the coil at right angles to the plane of the plates in the condenser. Or, more accurately, to put them in what is called " a conjugate position," in which the mutual induction is zero, so that currents in one do not induce currents in the other.

There are many such zero positions. A position of zero mutual induction is obtained when lines of force due to either coil do not thread the other—that is, do not pass through the condenser plates, in the particular case under consideration.

They may dip into it, but they must rise out again, passing through the plate on both journeys. They must not pass through the

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plate and then return outside. In other words, they must not effectively *cut* or thread the plate as if it were a secondary coil.

This is a kind of precaution that ought to be taken by makers of sets. And if they do not happen to be aware of it, they may be arranging metal conductors near coils without realizing that they are thereby introducing spurious effects, which anyhow are no good, and which, if strong enough, will do harm.

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