CHAPTER XVI

Some Disadvantages of Reaction

WHEN two coils are coupled inductively together, they react on each other, with the result that the inductance of each is diminished and the resistance of each is increased. Resistance is never wanted; it is always a nuisance, though unavoidable. That is why coils are wound so as to give as much inductance as possible for a given length of wire—that is, for a given resistance.

Inductance confers inertia on the current, like adding a mass of lead to a pendulum bob. It makes the oscillations persist, and it enables accurate tuning. Hence anything that diminishes the inductance and increases the resistance is to that extent deleterious. But there is more objection to reaction than that.

A coil and condenser circuit, if free and uncoupled, has a definite period of oscillation of its own, and is capable of precise tuning. When coupled up to another similar circuit, its oscillations are not free. It is rather like coupling two pendulums together; they are both hampered; one tries to share its frequency with the other.

The result is that you get a kind of double vibration, something like a three-legged race. Two men run much better when their legs are not coupled together. In the latter case they interfere with each other; neither has any longer an effective will of his own; and anything like *tight* coupling is manifestly a disadvantage.

In ordinary transformers all this has to be put up with. What is wanted then is a transmission of energy from the primary to the secondary coil. And to get the maximum transmission, the coupling must be tight. The two coils become in a sense one, and the connexion thus obtained is rather like direct connexion, without a coil at all. Inductive coupling is, in fact, simply a mode of effecting connexion and at the same time giving the option of increasing the voltage by what is called "transforming up"; which is attained when the secondary coil has a great many more turns than the primary. This is not a case of reaction in the technical sense.

Indeed, in the technical sense, reaction has a still more objectionable significance. A current, magnified by a valve and high-tension battery, is made to react upon some other non-magnified part of the circuit, and thus excite magnified vibrations in that, which once more

increases the vibrations in the magnified part, and these react again ; and so on, backwards and forwards, until you get a howl.

Just as when an ordinary telephone and a transmitter, short-circuited together through a single cell battery, are made to talk to each other ; the slightest disturbance in the telephone then affects the transmitter through the air, this affects the telephone through the wire and battery, and once more it reacts on the transmitter through the air, and that again acts through the wire. So that in a short time—which need be only the fraction of a second—the two set up a howl or scream of some kind, the pitch depending on the tone or tones of the telephone diaphragm.

Of course, this magnified kind of reactance gives more power ; and if the coupling is fairly loose, so that you are only on the verge of a howl, the arrangement is very sensitive. But it is not a good arrangement, and does not conduce to good tuning.

What it does conduce to, if the coupling in any way reaches the aerial, is to increase the oscillations in the aerial, turning that into a transmitter, instead of only a receiver—a transmitter, moreover, which is approximately of the right frequency, for it is its own vibrations which are worked up to a greater amplitude.

Hence the result is objurgations on the part of your neighbours, who are receiving from you instead of from the distant station they want to listen to, receiving not only the right note, but other notes near by, excited by your coupling arrangements. They cannot well tune these out because they are so near the right pitch, but it spoils their tuning; and if you press the coupling a little closer they will receive further howls.