CHAPTER XX

Phase Difference in Different Kinds of Coupling

TWO circuits may be coupled together either magnetically, or electrostatically, or by direct conduction; the latter being much the same as electrostatic connexion through a condenser. Hence either of these last may be called electric coupling, while the other may be called magnetic coupling.

Taken separately, the different modes of coupling produce much the same effect, transmitting the oscillations from an open circuit, like an aerial, to a closed and resonating circuit. But if the three modes of coupling are combined in one apparatus, they tend to interfere and neutralize each other's effect, as may be explained thus :—

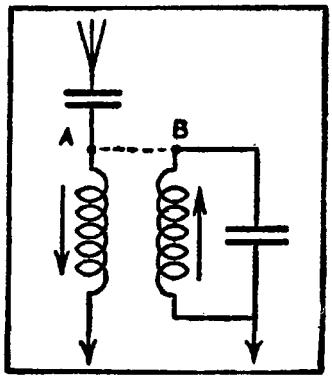
When a sinuous current is oscillating in a primary circuit, the E.M.F induced in a secondary circuit, depending as it does not on strength but on rate of variation, will lag a quarter phase behind the inducing current, being related to it as a cosine is to a sine.

The current excited in a secondary circuit, attuned by suitable inductance to the primary, will lag another quarter phase behind the

induced E.M.F., being related to it as a minus sine is to a cosine.

Consequently the current induced in an attuned circuit of negligible resistance will be exactly in opposite phase to the primary or inducing current, being related to it as a minus sine is to a sine. And the condenser in this secondary circuit, being charged and discharged by these induced currents, will be always in opposite phase to the condenser or capacity area in the primary circuit.

When the charge or potential of one is at maximum plus, the charge or potential of the other will be at maximum minus. That is the effect of magnetic coupling.



The arrows show primary inducing and secondary induced currents in a certain phase. The potential at A is accordingly falling, while the potential at B is rising, and *vice versa*. Consequently, if the points A and B are connected, as shown by the dotted line, the two modes of coupling will interfere and tend to neutralize each other.

But the effect of electric coupling is different. In electric coupling the two condensers are virtually united, so that the phase of potential or charge, in one, will correspond with the phase of potential or charge in the

other. Both reach their maximum plus and maximum minus together.

Hence if both couplings are employed simultaneously, they tend to interfere or neutralize each other's effect. And the couplings may be so adjusted as to produce the effect zero.

The diagram on page 153 may serve to illustrate this still further.

The importance of this will be recognized when a reinforcing circuit is used; that is to say, a free oscillator so connected as to respond only to a stimulus of one particular frequency and to exclude all others. The oscillations which it responds to are worked up to considerable amplitude by resonance provided the circuit is of low resistance and quite free from all magnetic coupling. It is stimulated by a single connector only, and its enhanced oscillations generate in its condenser a timed alternating difference of potential which can be carefully tapped off to excite grid or filament or both. Such a free circuit acts both as a selector and a magnifier, but it must not be coupled to the aerial, it must only be connected to it by a single wire or through a condenser which may be adjustable so as to vary the connexion. If doubly coupled it can act as a rejector.