

Result : Instead of a straight line inclined at 45° , we now observe an elliptical trace in the form of a closed curve.

Explanation : A phase shift has been introduced in the iron-cored coil. The current here lags behind the current and voltage waveforms in the coil without an iron core, for all instantaneous values. We have seen that phase differences of zero or even multiples of $\pi/2$ give rise to linear simple harmonic motions of sinusoidal character. All other phase differences give rise to elliptical oscillations. Special Case : Circular oscillations produced by phase differences of $\pi/2$ and odd multiples thereof, for equal amplitudes of the component oscillations.

Experiment No. 11 Lissajous Figures

Energise one of the two deflection coils with 2 V AC from the transformer unit and the other one from a bicycle dynamo. The latter must supply alternating current. Connect its output terminals directly to the coil. Mount the bicycle dynamo on a clamp stand and drive it via suitable reduction gearing.

Result : As the speed of rotation of the dynamo is increased, we obtain the familiar Lissajous figures in various versions.

Explanation : Very complicated oscillograms are often produced when the frequencies and amplitudes of two superimposed component oscillations bear no simple relationship to each other

Experiment No. 12 Electrostatic Deflection

The Cathode Ray Tube 6721 has been fitted with a pair of electrostatic deflector plates. In conjunction with the sawtooth generator module, these can be used as X-plates to trace a timebase line. One of the two deflector plates rests at anode potential.

Connect a DC voltage which is adjustable from zero to 50 V, between the two deflector plates. This voltage must be provided by a source which is independent of the anode voltage supply, e.g. a battery or a second mains power unit.

Result : The luminous spot is deflected to the side (horizontally).

Explanation : The cathode ray consists of moving electrons, which are negatively charged particles. When moving through the space between the plates of a capacitor, these electrons are attracted by the positive plate and repelled by the negative plate. In this sense the deflection capacitor functions like an optical prism; the electron beam suffers refraction when passing through it.

Introducing a Timebase

Experiment No. 7 employed the antiquated method of introducing a timebase with a rotating mirror in order to be able to display the time waveforms of arbitrary oscillations in a cartesian coordinate system. The luminous spot was moved horizontally and linearly with respect to time whilst oscillating up and down at the 50 Hz AC mains frequency, so that the trace was pulled apart to reveal the sinusoidal waveform.

The use of mechanical devices to produce timebases nowadays serves only to facilitate understanding of the process. It is simpler, more elegant