Oscillations in an Electromechanical System

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Experimental results are given on an oscillating electromechanical system in which, under a single frequency impressed electromotive force, mechanical vibrations are sustained at a frequency near the resonant frequency of the mechanical system and electrical oscillations at the difference between the frequency of the mechanical vibration and that of the impressed force.

The system is the one studied analytically by R. V. L. Hartley in an accompanying paper. Its performance conforms to the principal operating features predicted in his analysis.

IN AN accompanying paper [1] an analytic investigation is made of a system involving a non-linearity in the coupling between an electrical and a mechanical system. The electro-mechanical system under discussion is, in its simplest form, a condenser, with one plate sharply resonant mechanically, a generator, and an impedance, all connected in series. If the charge on the condenser is q, there will be a force on the mechanical system proportional to q^2. While the mechanical system and the electrical system involved are individually linear, there is a non-linearity in this electrostatic coupling, and hence the possibility exists of mechanical and electrical vibrations at other frequencies than the impressed frequency. On this basis the possibility of the generation of a mechanical vibration, *not at a harmonic of the impressed electromotive force*, and electrical currents at the difference between the frequency of the mechanical vibration and that of the impressed electromotive force was predicted by the analysis.

That the phenomenon discussed can occur was first verified by Mr. Eugene Peterson. A condenser microphone was given a mechanical resonance at 600 cycles per second, by cementing a small metal ball to the center of the diaphragm. An alternating electromotive force at 2200 cycles per second was impressed and the system given a series resonance at the difference frequency, 1600 cycles per second, by means of an inductance. When the impressed voltage was increased beyond a critical value mechanical vibrations suddenly built up and current of the difference frequency, larger in amplitude than the current of the impressed frequency, appeared in the electrical system. The same result was obtained using a prong of a tuning fork as the vibrating plate.

[1] "Oscillations in Systems with Non-Linear Reactance" by R. V. L. Hartley, in this issue of the *Bell Sys. Tech. Jour.*