From Power Circuit Breaker Theory and Design
Edited by C. H. Flurscheim
Chapter 2 on the Physics of circuit-breaker arcs
By M. P. Reece

2.3.15 Current chopping

'Current chopping' is used to describe the sudden reduction of the current in a circuit breaker (Young, 1952) to zero at a time other than the 'natural' instant of current zero. Careful measurements have elucidated a process by which blast-type breakers may chop. The circuit breaker is in series with an inductive circuit, usually having a large inductance. There are, however, local, often distributed, *LC* circuits, having frequency responses in the 10-100 kHz range, between the circuit breaker and its load, and these have a resonant frequency and a dynamic resistance at that frequency. As the power-frequency current in the arc falls towards zero, the arc diameter shrinks and the time constant shortens, so that the arc can exhibit the negative resistance of the static characteristics at higher and higher frequencies. The negative resistance of the arc (at the resonant frequency of the local *LC* circuit), which is effectively zero at large currents, becomes larger as the power-frequency current falls. At some stage, the negative resistance of the arc becomes larger than the positive dynamic resistance of the local *LC* circuit, and thus the resistance of thy whole circuit (arc and *LC* circuit) becomes negative. This is exactly the process used in the Poulsen arc transmitter in the early days of continuous-wave radio. When the total circuit resistance becomes negative in sign, high-frequency oscillations of the current in the arc build up, and, when the peak value of this h.f. oscillating current is equal to the instantaneous value of the power-frequency current, an 'artificial' current zero has been obtained, and the circuit breaker interrupts, diverting the residual power-frequency current into the shunt capacitance.