The Woodhall Variometer

In the days before semiconductors, radio sets used thermionic vacuum tubes ("valves"or "tubes") to amplify radio and audio signals sufficiently to drive a loudspeaker with adequate volume. In early days the vacuum tubes were the most expensive component, with a radio costing a week's wages of a professional earner. A selected radio signal needed to be separated from others of nearby frequencies, and a series of tuned circuits, combinations of capacitances and inductances, could achieve this "selectivity". But the tuned circuits needed to be variable, so that one could tune into stations of different frequencies. Variable capacitors were used for this, but more than two or three mechanically synchronised together was clumsy and difficult to construct with accuracy. One solution, used for many decades, was to change the frequency by subtracting the signal from that generated by a synchronised oscillator differing in frequency by a fixed amount. Then a series of tuned fixed frequency amplification stages, each with its own vacuum tube, would amplify this intermediate frequency signal, producing as much selectivity as required. But these "superhet" (supersonic heterodyne) receivers required at least four vacuum tubes in total and were correspondingly expensive.

An early alternative solution was to apply variable positive feedback to the radio signal amplification stage, feeding a portion of the output back through the tuned circuit to the input. This would have the effect of feeding the signal repetitively through a single tuned circuit, increasing the selectivity dramatically. Care had to be taken to avoid making the stage oscillate, which would swamp the incoming signal, and a variable coupling between the output and re-input could be adjusted to optimise the feedback. The variometer achieved this variable coupling, and was a radio frequency transformer with variable coupling between the two windings. The standard design had one coil fixed and the other attached to a spindle and rotated from being coaxial to at right angles to the fixed coil. Apart from taking up space and being cumbersome, the physical arrangement led to the inductance varying, which meant that one had to retune while adjusting the coupling. This unwanted effect was less pronounced with the Woodhall variometer, which was also more compact. The Woodhall variometer consisted of two coils wound round concentric spheres, one turning on a spindle. When the windings were parallel maximum coupling existed between the coils, and minimum when the windings were at right angles. The arrangement was physically more compact.