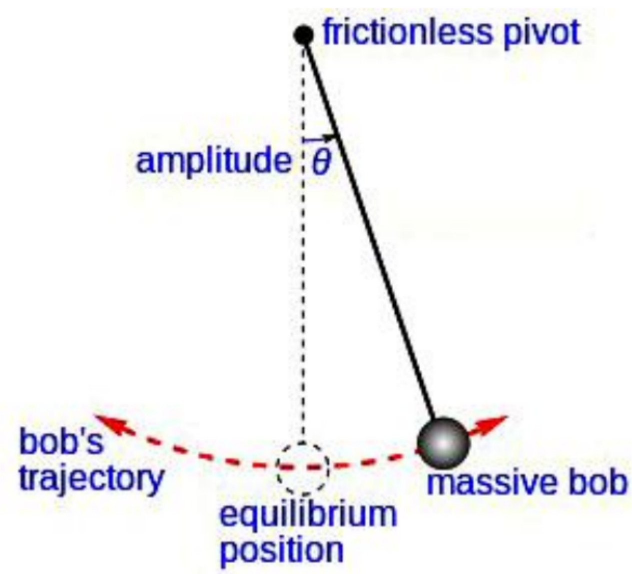
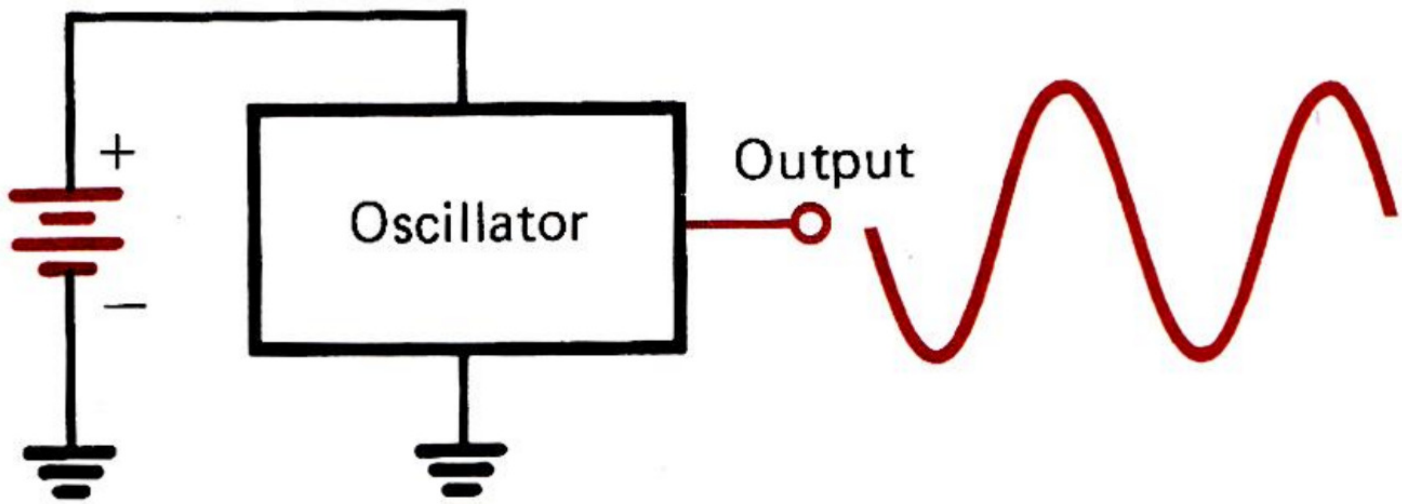
The New England Radio Discussion Society electronics course (Phase 4, cont'd)



Introduction to Oscillators

AI2Q – March 2017

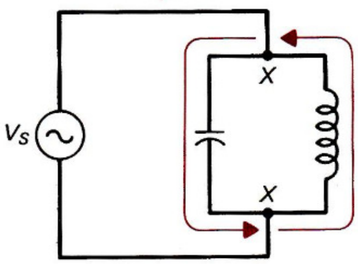
Oscillators – What Do They Do?

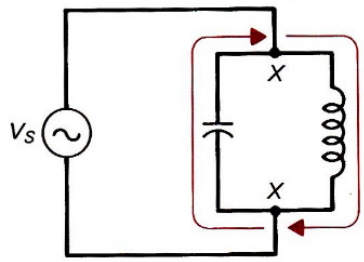


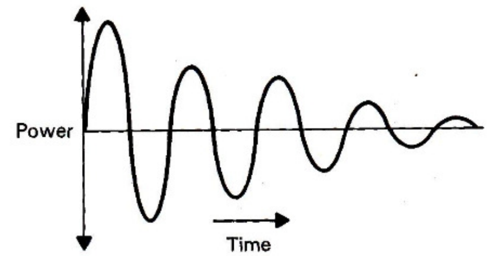
They convert DC into AC!

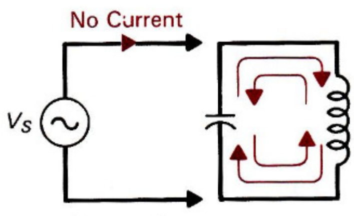
Your rig is therefore a fancy "oscillator."

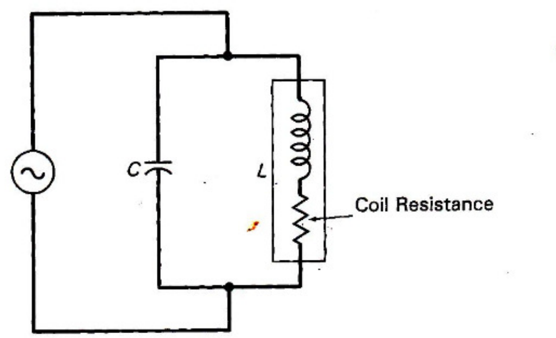
Recall the back-and-forth oscillating signal in the parallel anti-resonant circuit.





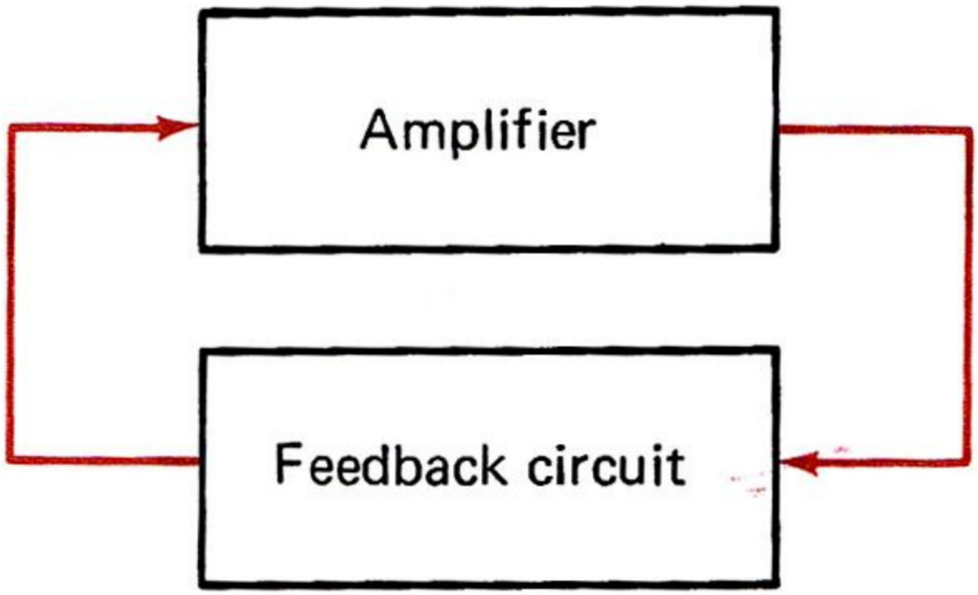




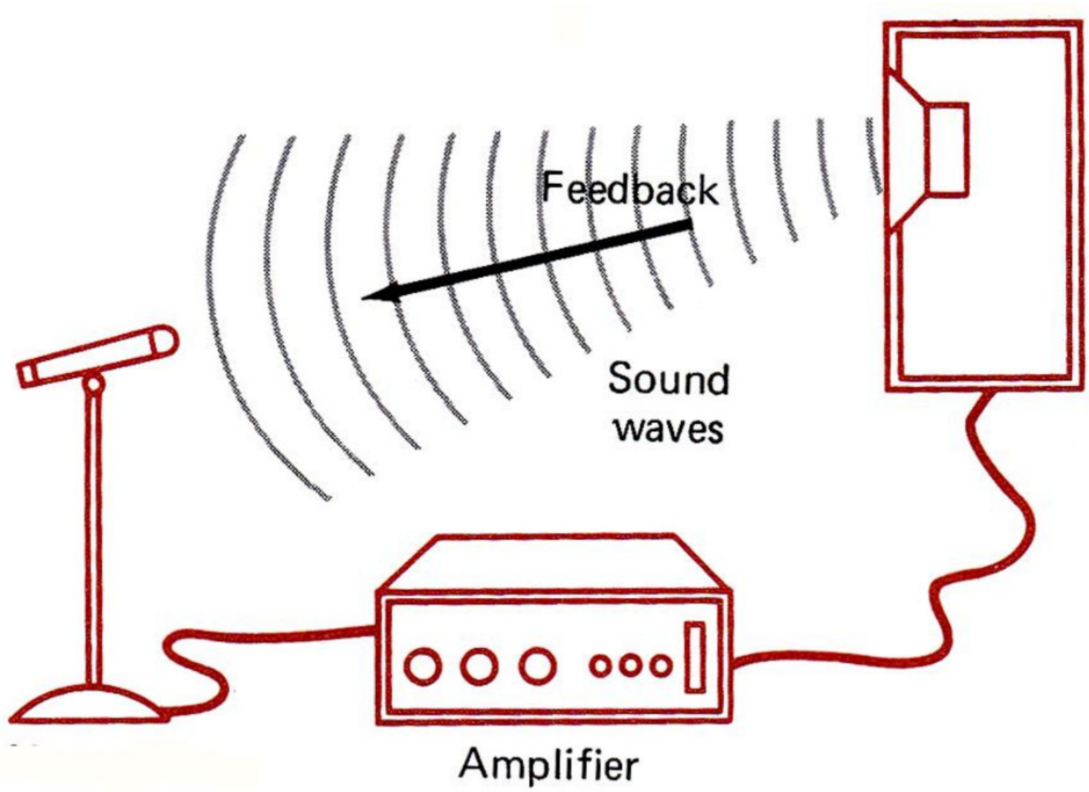


It created a damped ac signal, or waveform.

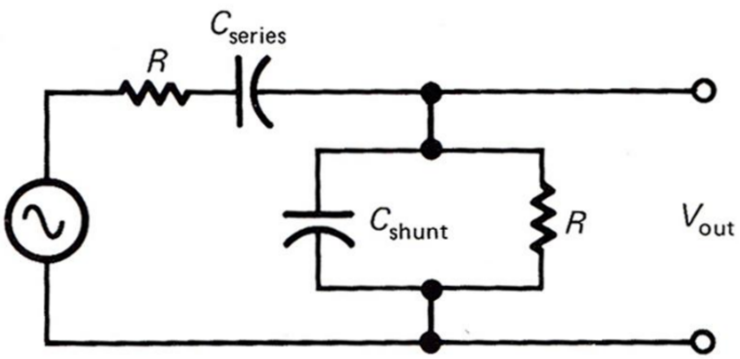
Oscillators are comprised of amplifiers with feedback.

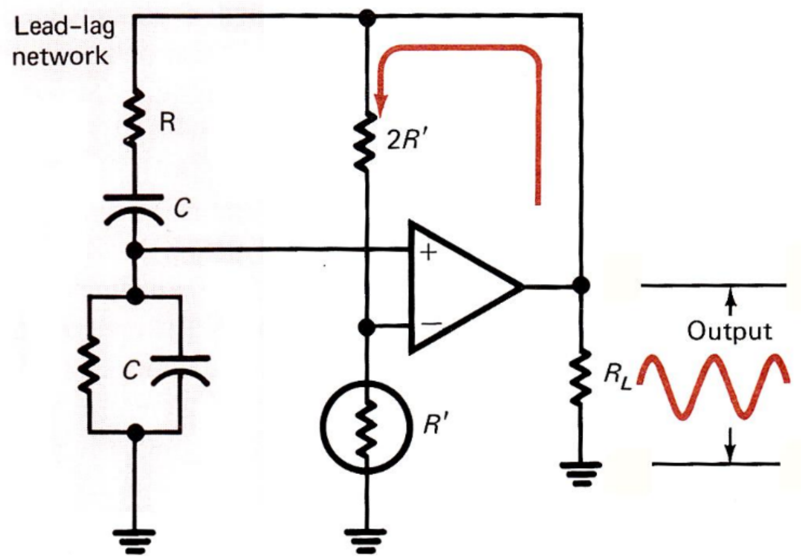


The howl from the loudspeaker is due to feedback!



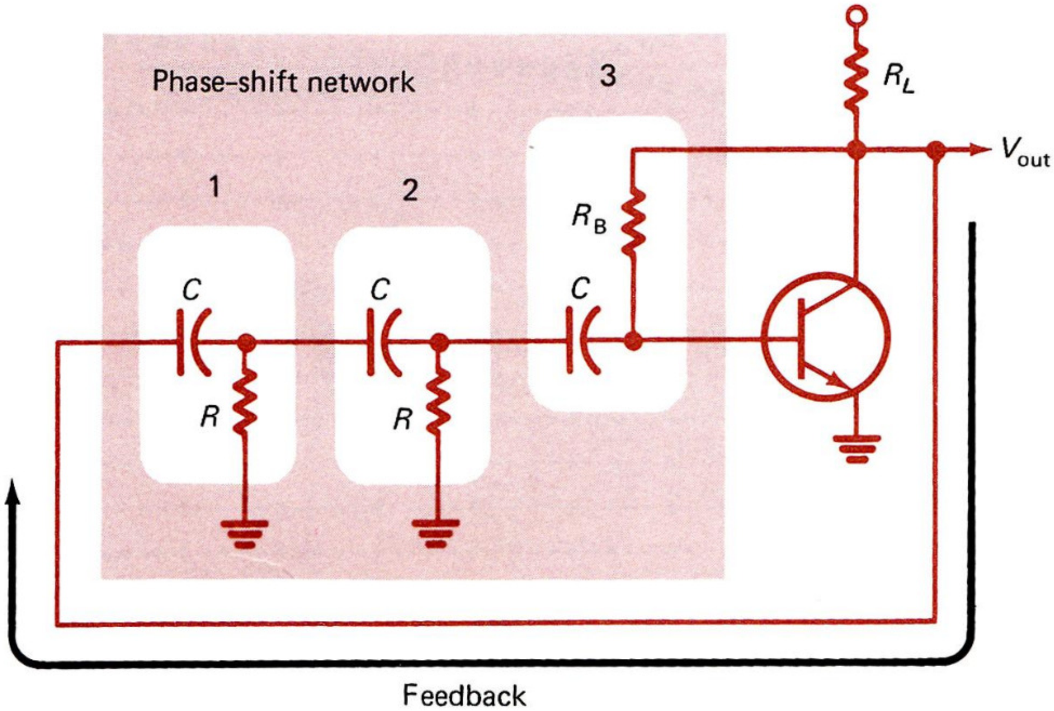
A very stable type of oscillator, usually used at audio frequencies, is the Wien bridge oscillator**. The circuit uses a resistive lead-lag network an an op-amp.**





The gain automatically adjusts to prevent clipping, but is maintained larger than the losses in the feedback circuit.

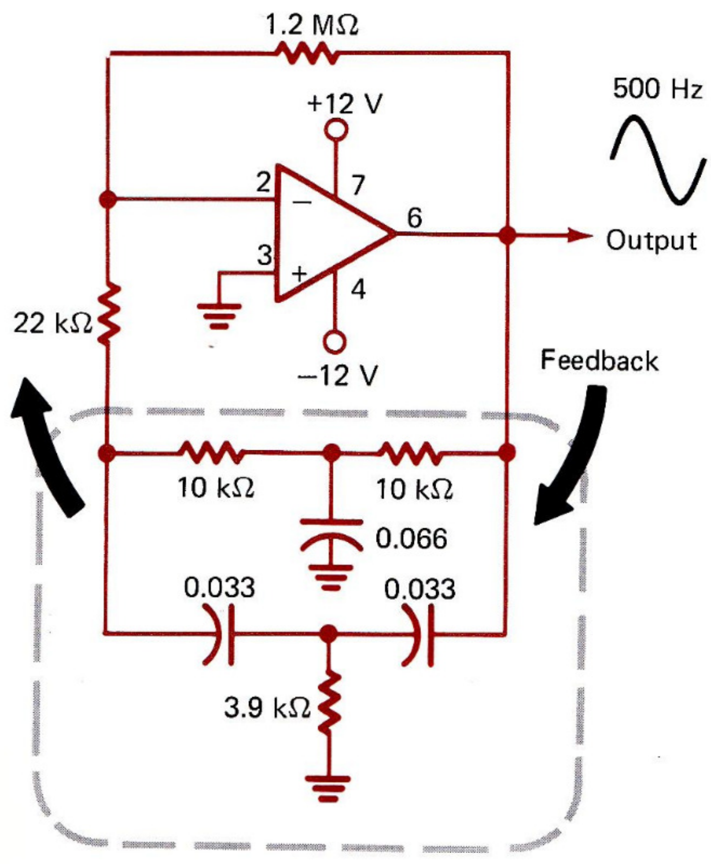
Here's a phase-shift oscillator. It's also typically used at audio. In this example, each section contributes to 60 degrees of shift.



Phase-shift oscillators produce very low-distortion sinewave signals.

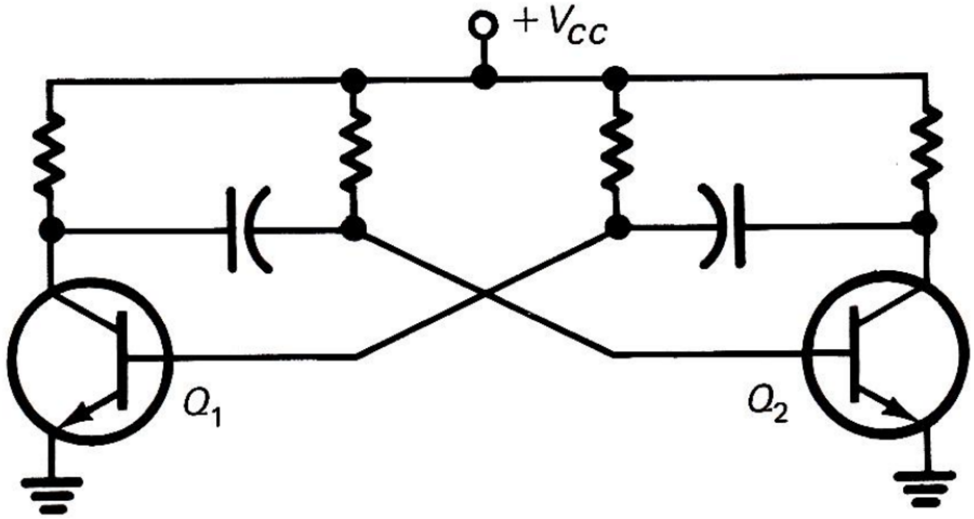
This is an actual circuit for a Twin-T audio oscillator.

This twin-T circuit uses an operational amplifier chip, but discrete component amplifiers are often used as well.



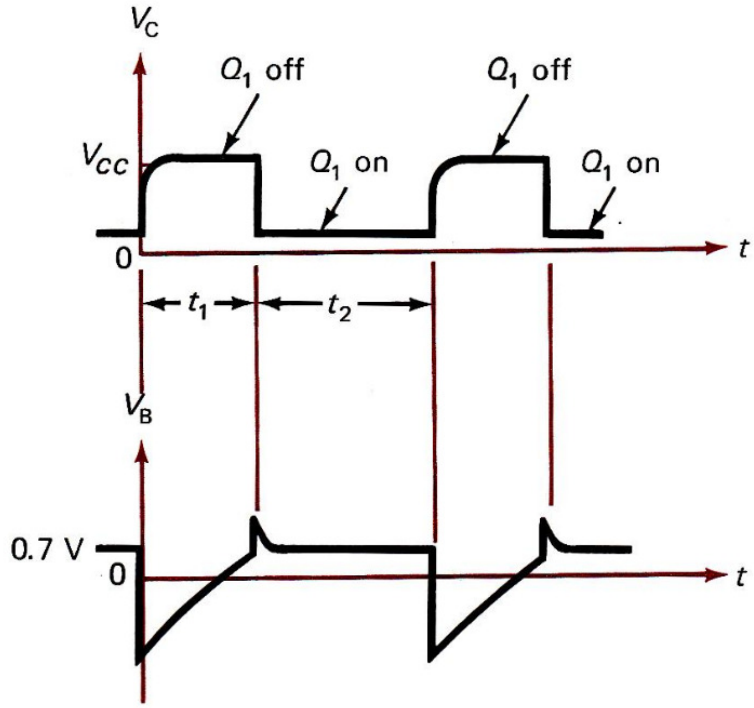
Two transistors can be connected as a free-running flip-flop. This is also referred to as a multivibrator.

One transistor conducts while the other is cut off. After a fixed RC period these roles reverse. The waveform is quite distorted but can be used for timing purposes.



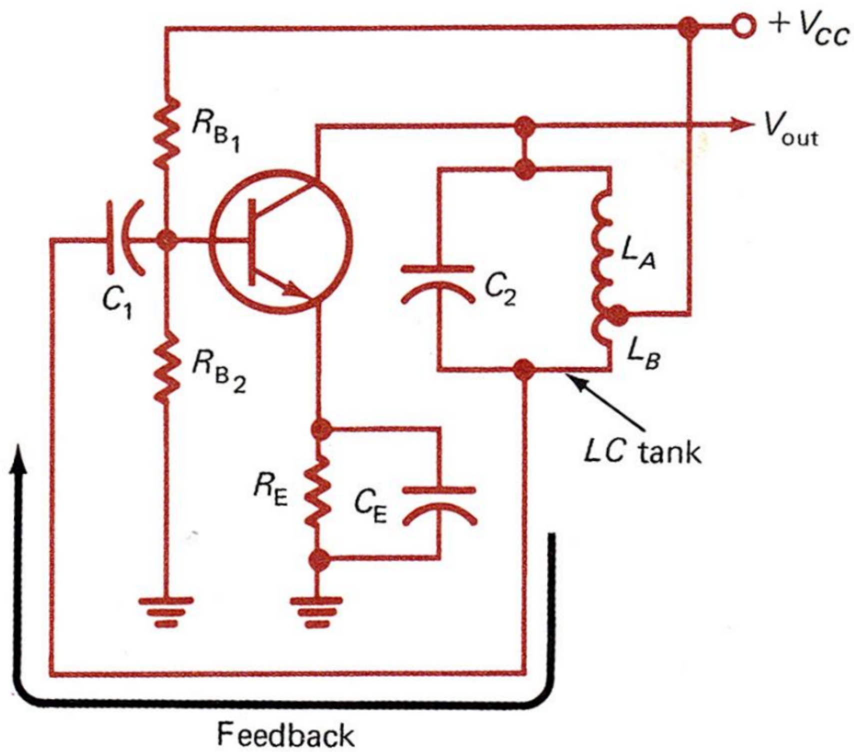
Here's the typical output wave shape of a multivibrator.

The RC time constants of the circuit (previous slide) determine the frequency of operation.



Now let's look at some RF oscillator circuits.

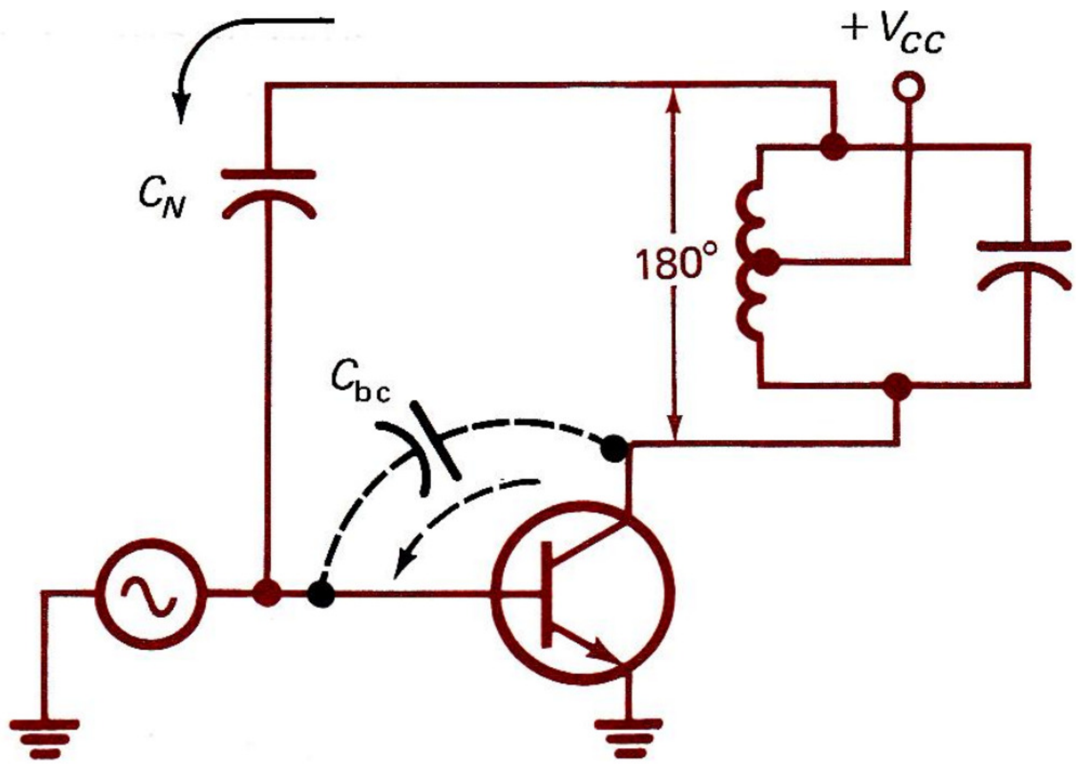
This discrete-component circuit, operating with L-C values at RF, is called a Hartley oscillator. It's recognizable by its tapped inductor.



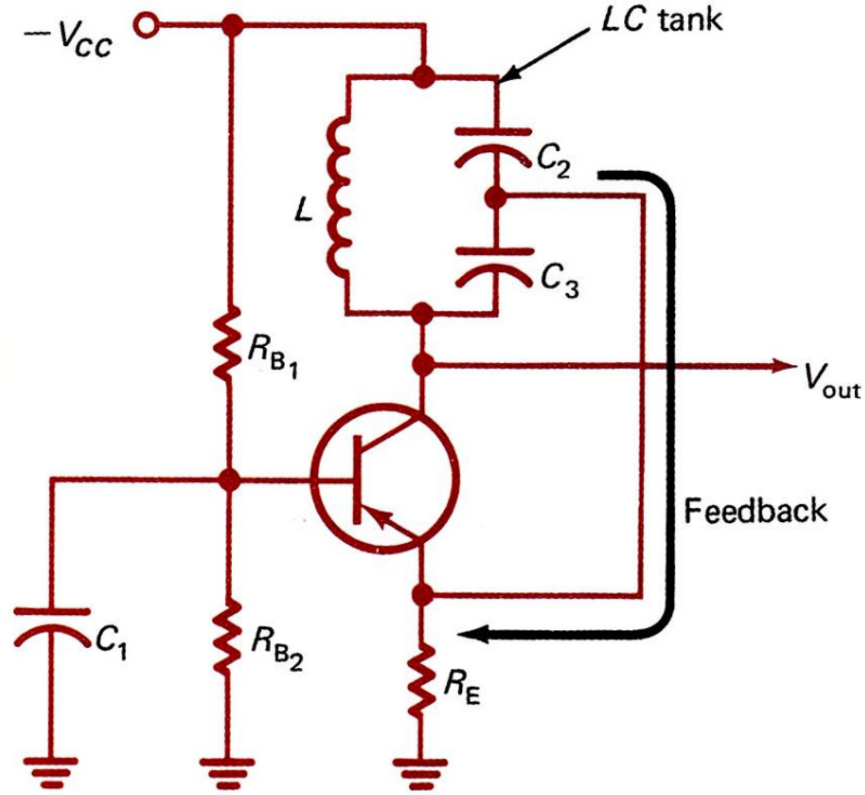
The parallel resonant circuit produces 180 degrees of phase shift at resonance.

The tap position sets the level of the feedback.

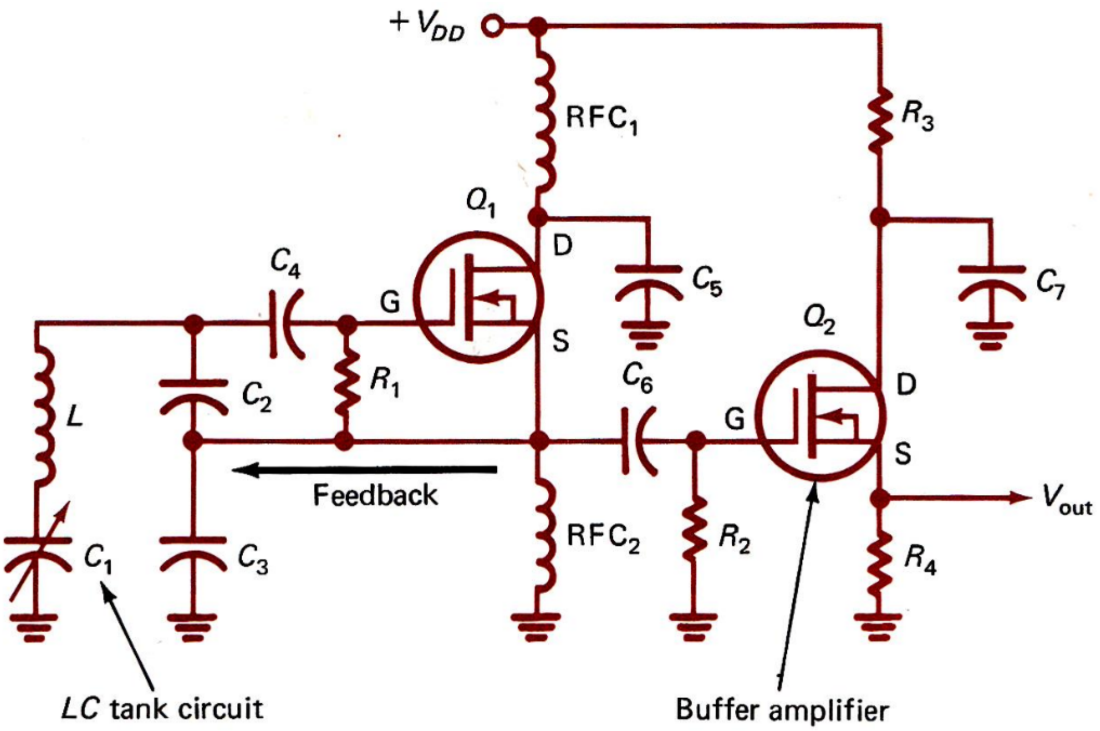
Feedback can occur externally as well as internally.



The Colpitts oscillator is recognizable by a tapped capacitor in the LC circuit.

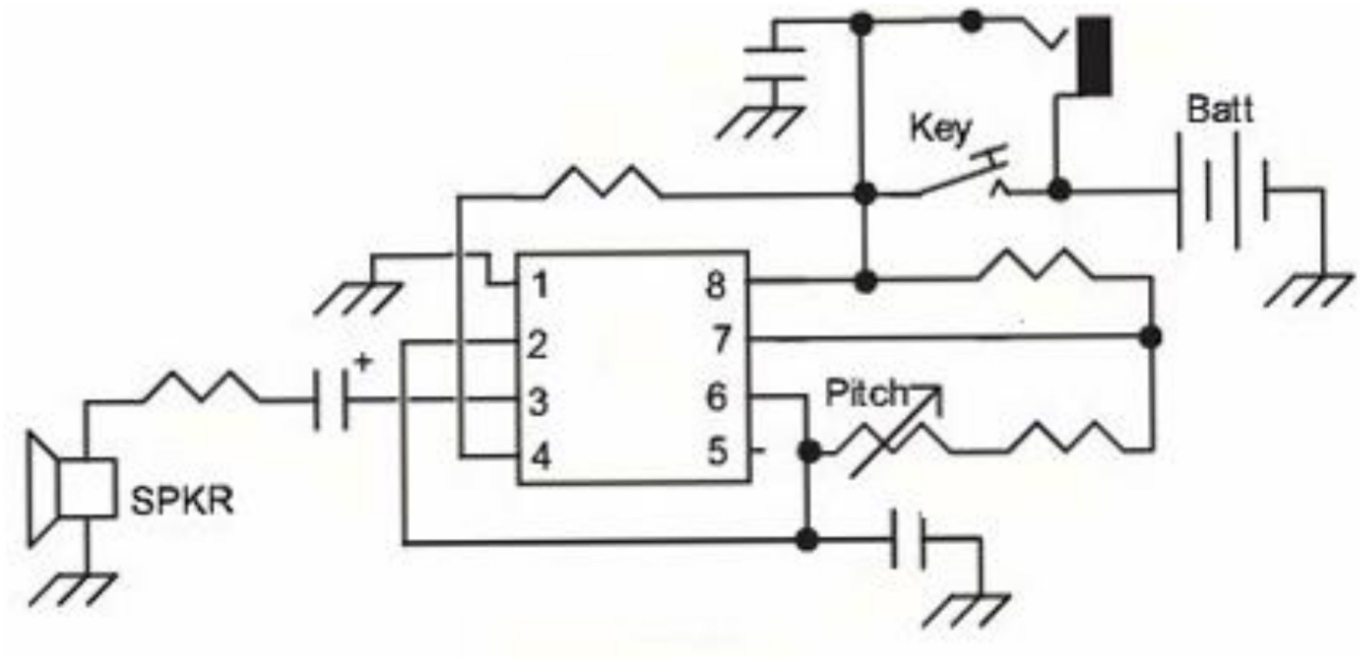


Here's what is essentially a practical series-tuned Colpitts, but it's referred to as a Clapp oscillator**.** **It is a** VFO **(variable frequency oscillator). Clapp oscillators are stable at RF; they don't** drift **very much.**



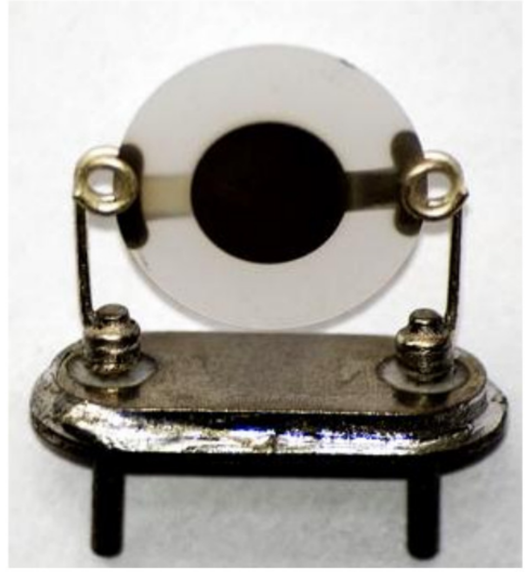
Notice the source follower **buffer amplifier.**

Integrated circuits can also serve as oscillators. For example, the venerable 555 **timer chip can be wired as an oscillator. This example circuit, from the** ARRL Handbook**, shows a typical 555 used as a code practice oscillator.**



Quartz crystals can also be cut and used as oscillating elements. Crystal oscillators are very stable. In years past, natural crystals were used for this purpose. Today, many crystals are artificially fabricated. They're called synthetic crystals.

Here's what a finished synthetic crystal looks like. →



This crystal's sealed package has been removed to reveal its inner structure.

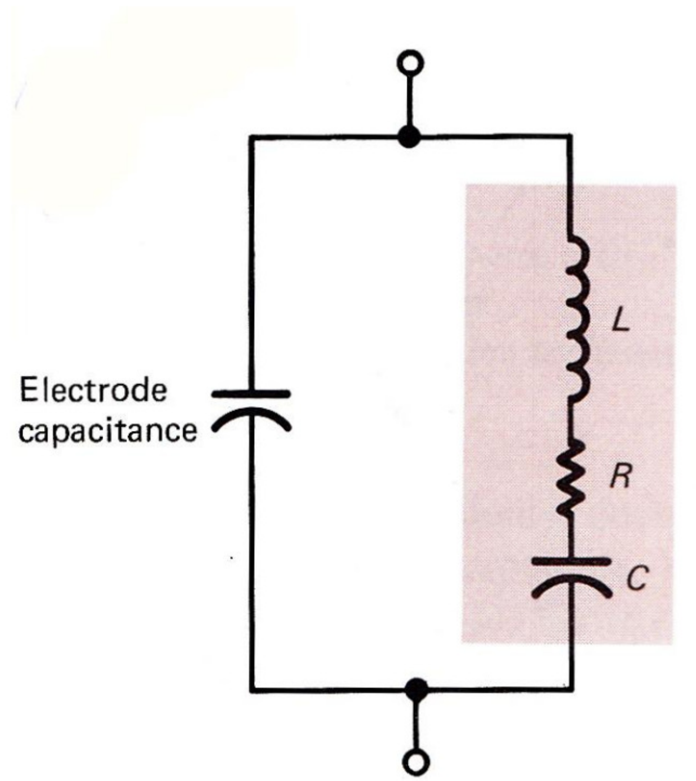
← This crystal package is called an FT-243 (WWII vintage).

Note the ceramic socket the crystal package plugs into.

The quartz crystal has an electrical equivalent circuit**. In this example the crystal is represented by the series circuit.**

The package's stray electrode capacitance is in parallel with the series circuit.

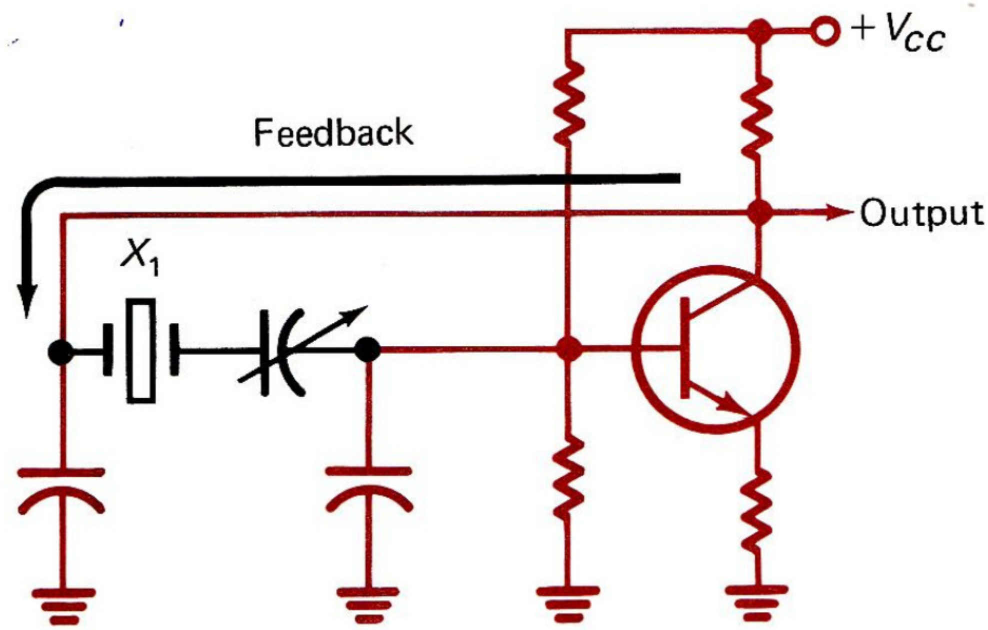
The physical thickness of the crystal decreases as the frequency goes up. At higher frequencies overtone oscillators **are used, tuned to** harmonics, **as the crystals get physically too thin.**

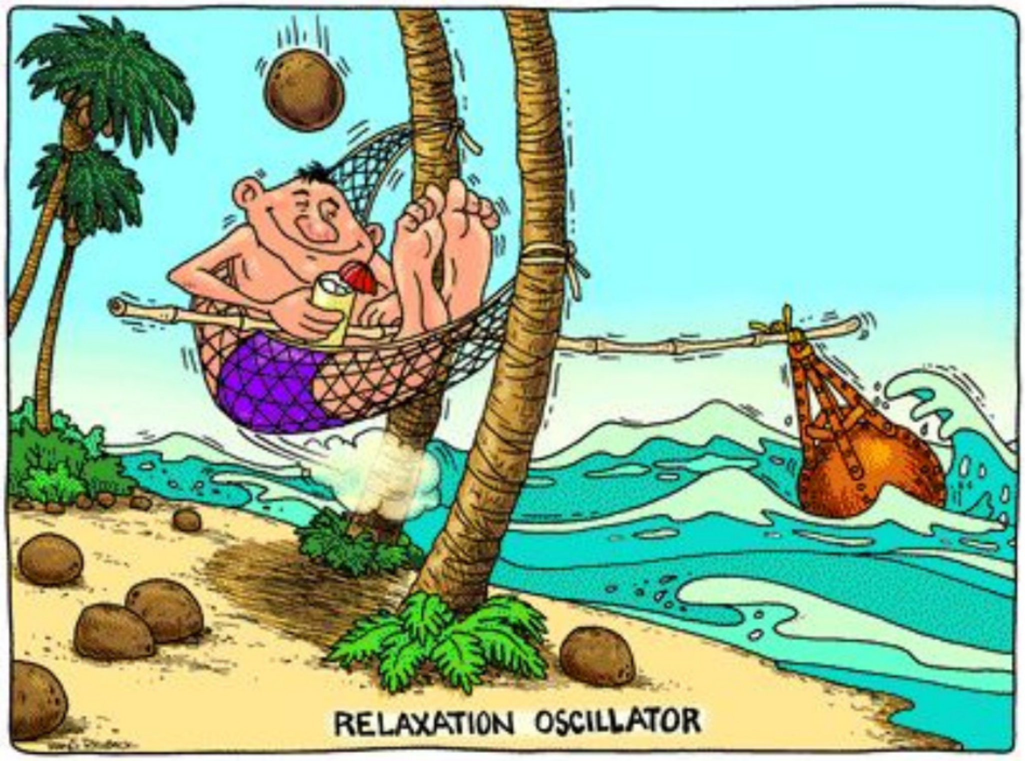


Here's a typical crystal oscillator using an NPN BJT.

The 180-degree feedback is provided by the quartz crystal.

The variable capacitor can trim the circuit to an exact frequency.





Until next time, 73 de AI2Q