Some Innovations in 1920s Radios
Extracted from the book Behind the Front Panel by David Rutland

YEAR	INVENTOR	INVENTION – ADVANTAGES AND DISADVANTAGES (page number)	SEEN IN THIS MAKE/MODEL RADIO
1904	John Fleming	Diode vacuum tube – converts alternating current to pulsating direct current.	
1906	Lee de Forest	Adds a third element (grid) to diode tube, creating a triode that can both detect a radio signal and amplify it.	
1914	Edwin Armstrong	Regenerative detector – tickler coil from plate feeds back signal to grid for significant amplification over a crystal radio. However, too much feedback causes oscillation… transmission of radio signals interfering with nearby radios. (26)	Clapp-Eastham model HR, 1924
1917	Edwin Armstrong	During WWI, Germany was transmitting signals between 500 and 3000 KHz – beyond the capability of Allied radios to receive (their RF amplifiers were ineffective beyond 100 KHz). He invents the superhetrodyne circuit, which converts higher frequency broadcasts to a lower "intermediate" frequency of 100KHz that can be successfully amplified. Eight tubes required. (115)	
1921	Irving Langmuir (GE)	Adds thorium to current tungsten tube filaments. The new thoriated tungsten filaments reduce required current from 1 amp per tube to 250 milliamps. Used in the standard 201A (01A) tube for RF and AF amplifiers and the 200A tube for detectors (slightly gassy – found to improve performance). (108)	
1923	Westinghouse	Invents the WD11 tube which can run on a single 1.5 volt dry cell in a portable radio. Made possible by using a rare earth oxide in the filament. (108)	Aeriola
1923	General Electric (G. E.)	Invents the UV 199 tube with a 3 volt filament, operated with 3 dry cells. (109)	
1924	Armstrong, Houck	Succeed in reducing the superhet tube requirement from 8 to a more affordable 5, making it more competitive with two stage TRF sets	Radiola AR812
1924	A W Hull, G. E.	Discovers that a second grid (the "screen"), installed between the grid and plate, not only solves the capacitance problem but amplifies by 60X vs. 01A triode tubes amplifying at 10X to 15X. (110)	
1925	Scott & McMurdo Silver	Introduce highly sensitive best selling superhet kits. (122)	Silver Marshall
1927	RCA	Introduces the UX222 with a screen grid and 3.3 volt filament as a direct replacement for its UV 199 tube (above) used in portable radios.	Automatic Radio's Tom Thumb; RCA Radiola 21
1927	RCA	UX 221 A (5 volt filament) introduced as a higher power output tube to replace the UX201A in the final AF stage. (111)	RCA Radiola 21
1927	RCA	Introduces the UV227 tube, the first to have a heating element separate from the electron emitting cathode, enabling radios to use alternating current (AC) yet not having a 60 cycle hum (because the AC current on the heating element is not picked up by the cathode0. (131)	Freshman Q15 AC radio RCA Radiola 62 AC radio
Early 1920s	?	Radio frequency (RF) amplifier – weak grid signal voltage replicated and amplified onto the strong plate current, enabling greater sensitivity to receive weak stations. However, capacitance between grid and plate could cause the circuit to become unstable (oscillate) at higher AM band frequencies. (31)	Grebe CR-13, 1923
?	C. D.Tuska (ARRL founder)	Superdyne circuit – uses a tickler coil to feed back an opposite polarity voltage to cancel out the capacitance leakage. However, this solution was not practical, because the amount of feedback needed to be manually adjusted at different frequencies. (34)	
1923	Hazeltine	Neutrodyne circuit – winds the secondary coil opposite to the primary and uses a small "neutralizing" capacitor (later a coil) to feed back a voltage that cancels the capacitance voltage. Set at the factory, no user adjustments required. Adopted as the best solution (37). Downside – licensing fee added cost to radios.	
1923	Drake	Discovers that RF transformers lose significant amplification due to capacitance between the primary and secondary du to their design. Creates a new design with a "slot coil" (coil in the slot of a wooden disc), installed near the ground end of the secondary, resulting in much greater amplification. Very sensitive, outperforming radios with multiple RF stages. Adopted as the best solution (39).	Early Browning Drake radios, manufactured by National.

Mid 1920s	Hazeltine	Mathematically proves that installing RF transformers at an angle of 54.7 degrees to a common center line is the best way to prevent unwanted interstage signals (44).	
1922	F.A.D. Andrea	Markets a radio with 3 stages of neutralized RF amplification and a NON-regenerative detector, eliminating the oscillation (transmitting) and noise (squeaks and howls) problem of Armstrong's regenerative radio. Called a Tuned Radio Frequency (TRF) radio, it had a large dial to tune each of the three stages. (46)	FADA One-Sixty
1924	Grebe	Markets a radio with tuning capacitor plates designed to linearly spread out stations across the entire 0-100 dial, rather than bunching high frequency stations at the top end. (48) The radio also has "binocular" coils in each RF transformer, would in opposite directions, so that any extraneous capacitance voltage would be canceled out by the opposite winds. Two RF stages, a non-regenerative detector and two AF stages become the TRF radio standard (49).	Grebe Synchrophase MU-1
Mid 1920s	Atwater Kent	Avoids paying the neutrodyne patent licensing fee (7.5% of sales) to Armstrong by careful physical arrangement of components to minimize stray coupling and by reducing gain from its ideal value to prevent problems (while still providing sufficient amplification) by adding a grid resistor. This also reduces parts costs and neutralization labor costs. (54)	Atwater Kent 20
1923	Freshman	Also avoids the neutrodyne patent by mounting the RF transformer on the rear of the metal variable capacitor tuner, having the same effect as above but without the cost of the grid resistor. Inexpensive to build – few components. (56)	Freshman Masterpiece
1917	Marius Latour (Fr.)	Invents the reflex circuit, using a single tube for both RF and AF amplification, reducing radio costs. (98)	Crosley Tridyn, 1923
1926	Grebe	Mechanical linkages are added, moving all three tuning dials at once – simplifying tuning by having a single tuning dial. (64)	Grebe Synchrophase
1925	Thompson	Creates a single tuning dial using a lever operating dial cords to the tuning capacitors. (71)	Thompson Minuet
1926	Dreyer & Manson	Begin using metal shielding to prevent interstage stray signals from causing instability (oscillation). Eliminate the need for reducing gain to prevent this problem and also improves selectivity. (86)	Stromberg-Carlson 601
1928	Not mentioned	Audio transformers used in telephone repeaters (enabling long distance calls) only had a linear response range from about 300 to 3000 Hz. A new AF transformer is developed with linear response from 60 to 5000 Hz still adequate for today's AM radios. (94). Note: AF transformers had thousands of turns in the secondary with wires only a few thousandths in diameter – expensive to make. (95)	American Bosch (model not specified)