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## Early FM Radio

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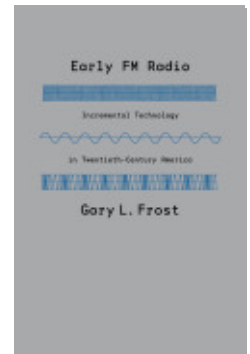
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## *FM-Related Patents, 1902–1953*

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Patents are listed in order of filing date. Except for Poulsen's Danish Patent No. 5,590, all patents shown are U.S. patents, which can be viewed on the U.S. Patent and Trademark Office Web page, [www.uspto.gov/](http://www.uspto.gov/).

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Ehret, Cornelius D.	Art of Transmitting Intelligence	First FM patents. Antifading.	None	785,803	10 Feb. 1902	28 Mar. 1905
Ehret, Cornelius D.	System of Transmitting Intelligence	First FM patents. Antifading.	None	785,804	10 Feb. 1902	28 Mar. 1905
Poulsen, Vlademar	Method for Generating Alternating Current with High Frequencies	Arc oscillator using FSK	None	5,590 (Danish)	9 Sept. 1902	3 Apr. 1903
Hammond, John Hays, Jr.	Radio Telegraphy and Telephony	FSK for telegraphy. Amplitude modulation for telephony.	None	1,320,685	29 May 1912	4 Nov. 1919
Hewitt, Peter Cooper	System of Electrical Distribution	FM transmitter with conducting gas or vapor oscillator	None	780,999	13 Dec. 1913	25 Feb. 1919
Nelson, Edward L.	Modulating and Transmitting System	FSK with audion amplifier	WE	1,349,729	8 Mar. 1918	17 Aug. 1920
Day, Albert V. T.	Method and Means for Electrical Signaling and Control		None	1,885,009	25 Jan. 1919	25 Oct. 1932
Taylor, Albert Hoyt	Simultaneous Transmission or Reception of Speech and Signals	FSK telegraphy, with AM of two wavelengths	None	1,376,051	10 Apr. 1919	26 Apr. 1921
Nyman, Alexander	Combined Wireless Sending and Receiving System	Uses a Poulsen arc	WEM	1,615,645	15 July 1920	25 Jan. 1927
Little, Donald G.	Wireless Telephone System		WEM	1,595,794	30 June 1921	10 Aug. 1926
Conrad, Frank	Wireless Telephone System	FM transmitter	WEM	1,528,047	15 Mar. 1922	3 Mar. 1925

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Purington, Ellison S.	Radiant Signaling System	Transmitter and receiver. "Wobble from a wave length of 505 to 526 meters, which would cause the mean value of the wave length to be 515.5 meters." Corresponds to a center frequency of 581,851 cps, with a frequency swing of 23,703 cps.	JHH	1,599,586	27 Apr. 1922	14 Sept. 1926
Mertz, Pierre	Electrical Transmission of Pictures	Transmitter and receiver. FM for wired transmission of pictures. Limiter.	AT&T	1,548,895	26 Jan. 1923	11 Aug. 1925
Sivian, Leon J.	Means and Method for Signaling by Electric Waves	Transmitter and receiver. Describes a narrowband FM system with a channel width of 4,000 cycles.	WE	1,847,142	5 Dec. 1923	1 Mar. 1932
Schelleng, John C.	Electric Wave Signaling System	Transmitter and receiver	WE	1,653,878	22 Dec. 1923	27 Dec. 1927
Shanck, Roy B.	Picture Transmitting System	Transmitter and receiver	AT&T	2,115,917	12 Mar. 1925	3 May 1938
Hartley, Ralph V. L.	Electric-Wave-Modulating System		WE	1,633,016	7 July 1925	21 June 1927
Wright, George Maurice, and Smith, Sidney Bertram	Radio Transmission and Reception of Pictures	Transmitter and receiver. Limiting in FM for pictures. Antifading. Antistatic.	RCA	1,964,375	20 Feb. 1926	26 June 1934
Long, Maurice B.	Electrical Transmission System	Transmitter and receiver	WE	1,977,683	22 May 1926	23 Oct. 1934
Mohr, Franklin	Transmission System	Transmitter only	WE	1,715,561	26 May 1926	4 June 1929
Coleman, John B.	Transmitting System	Transmitter only. Electronic coupled telegraph keying.	WEM	1,920,296	7 Aug. 1926	1 Aug. 1933
Alexanderson, Ernst F. W.	Transmission of Pictures	Transmitter and receiver. Antifading.	GE	1,830,586	9 Aug. 1926	3 Nov. 1931

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Demarest, Charles S.	Signaling System	Transmitter and receiver. Limiting in FM receiver.	AT&T	2,047,312	1 Dec. 1926	14 July 1936
Conrad, Frank	Radio Communication System	Transmitter and receiver. FM balanced discriminator.	WEM	2,057,640	17 Mar. 1927	13 Oct. 1936
Chireix, Henri	Means for Radio Communication	Transmitter and receiver. Efficient phase modulation.	None	1,882,119	6 May 1927	11 Oct. 1932
Armstrong, Edwin H.	Radio Telephone Signaling	Transmitter and receiver. Narrowband FM.	None	1,941,447	18 May 1927	26 Dec. 1933
Trouant, Virgil E.	Radio Transmitting System	Electronic modulation. Improvement on Conrad Patent No. 2,057,640.	WEM	1,953,140	18 June 1927	3 Apr. 1934
Peterson, Harold O.	Signaling by Frequency Modulation	Transmitter and receiver. Use of FM to narrow channel width. Antifading.	RCA	1,789,371	12 July 1927	20 Jan. 1931
Armstrong, Edwin H.	Radio Signaling System	FSK	None	2,082,935	6 Aug. 1927	8 June 1937
Hansell, Clarence W.	Communication by Frequency Variation	Transmitter and receiver. Wobbling. Multiplexing. Balanced frequency modulator. Spectrum conservation. Receiver limiting. Magnetic wobbler or capacity variation or resistance modulation.	RCA	1,819,508	11 Aug. 1927	18 Aug. 1931
Usselman, George Lindley	Frequency Modulation	Transmitter and receiver. Uses balanced circuits in transmitter to suppress harmonics and ensure a constant amplitude.	RCA	1,794,932	1 Sept. 1927	3 Mar. 1931
Trouant, Virgil E.	Radiotransmitting System	Transmitter only. Crystal-controlled oscillator. Narrowband FM.	WEM	1,872,364	8 Oct. 1927	16 Aug. 1932
Albersheim, Walter S.	Method and Means for Signaling by Frequency Fluctuation	Transmitter and receiver. Improved linearity when modulating with small frequency deviation.	RCA	1,999,176	28 Jan. 1928	30 Apr. 1935

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Jones, Lester L.	Variable Relay Condenser	Nonmechanical high-speed variable condenser for FM	None	1,777,410	6 Mar. 1928	7 Oct. 1930
Hansell, Clarence W.	Oscillation Generation	A more stable FM transmitter. Antifading.	RCA	1,787,979	23 Mar. 1928	6 Jan. 1931
Hansell, Clarence W.	Frequency Modulation	Transmitter only. Narrower channel width and antifading. Wobbler. Greater efficiency.	RCA	1,830,166	23 Mar. 1928	3 Nov. 1931
Trouant, Virgil E.	Radio Station	Transmitter and receiver	WEM	1,861,462	3 May 1928	7 June 1932
Potter, Ralph K.	Electrooptical Image-Producing System	Transmitter and receiver. Phase modulation for pictures.	AT&T	1,777,016	19 May 1928	30 Sept. 1930
Hansell, Clarence W.	Signaling	Transmitter and receiver. Multiplex signaling on a high frequency carrier. Limiter in receiver.	RCA	2,103,847	2 Oct. 1928	28 Dec. 1937
Hansell, Clarence W.	Signaling	Transmitter and receiver. Antifading. Limiter in receiver. Heterodyne in transmitter. Spectrum conservation.	RCA	1,803,504	5 Oct. 1928	5 May 1931
Beverage, Harold H.	Signaling	Transmitter and receiver. Spectrum conservation. Antifading.	RCA	1,849,608	19 Nov. 1928	15 Mar. 1932
Hansell, Clarence W.	Detection of Frequency Modulated Signals	Receiver only. Circuit to "limit the amplitude of the received alternating energy so greatly that the output current is practically square in wave form."	RCA	1,813,922	30 Jan. 1929	14 July 1931
Hansell, Clarence W.	Detection of Frequency Modulated Signals		RCA	1,867,567	1 Feb. 1929	19 July 1932
Hansell, Clarence W.	Detection of Frequency Modulated Signals	Receiver only. Limiter circuit. Alternative to slope detector. Makes more linear the resonance curve used in detection.	RCA	1,938,657	1 Feb. 1929	12 Dec. 1933

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Ranger, Richard Howland	Wobbled Frequency Superheterodyne System	Transmitter and receiver	RCA	1,830,242	22 Mar. 1929	3 Nov. 1931
Hammond, John Hays, Jr.	Transmission of Light Sequences by Frequency Variation	Transmitter and receiver. FM, for both radio and light waves.	None	1,977,438	18 May 1929	16 Oct. 1934
Hammond, John Hays, Jr.	Transmission of Intelligence by Frequency Variation	Transmitter and receiver	None	1,977,439	18 May 1929	16 Oct. 1934
Hammond, John Hays, Jr.	Transmission of Light Variations by Frequency Variations	Transmitter only. FM of radio and light waves.	None	2,036,869	18 May 1929	7 Apr. 1936
Hansell, Clarence W.	Frequency Changer	Used to wobble a transmitter frequency	RCA	1,874,982	20 June 1929	30 Aug. 1932
Böhm, Otto	Signaling by Frequency Modulation	Transmitter only. Simple FM modulation of a crystal oscillator.	TGFDT	1,874,869	8 July 1929	30 Aug. 1932
Dome, Robert B.	Frequency Modulation	Transmitter only. Gives as a "practical example" a frequency swing of 20,000 cycles, after multiplying by 100.	GE	1,917,102	22 July 1929	4 July 1933
Schriever, Otto	Signaling	Transmitter and receiver	TGFDT	1,911,091	3 Sept. 1929	23 May 1933
Van Der Pol, Balthasar	Device for Modulating the Frequency of Electric Oscillations	Transmitter only. Uses light-sensitive cells to frequency-modulate high-frequency oscillations.	RCA	1,876,109	20 Nov. 1929	6 Sept. 1932
Hansell, Clarence W.	Signaling	Transmitter only. Limits the channel width of the transmitter with a bandpass filter.	RCA	1,849,620	16 Jan. 1930	15 Mar. 1932
Day, Albert V. T.	Carrier Wave Signaling	Transmitter and receiver	None	2,164,032	14 Feb. 1930	27 June 1939

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Hansell, Clarence W.	Detection of Frequency Modulated Signals	Receiver only	RCA	1,922,290	14 May 1930	15 Aug. 1933
Hansell, Clarence W.	Frequency Modulation	Transmitter only. Long-line frequency controlled oscillator.	RCA	2,027,975	25 June 1930	14 Jan. 1936
Roberts, Walter van B.	Frequency Modulation	Transmitter only	RCA	1,917,394	10 July 1930	11 July 1933
Armstrong, Edwin H.	Radio Signaling System	Transmitter and receiver	None	1,941,066	30 July 1930	26 Dec. 1933
Goldstine, Hallan Eugene	Modulation of Oscillations	Increased efficiency	RCA	2,067,081	31 Jan. 1931	5 Jan. 1937
Wasserman, Marian George	Frequency Multiplication	Applicable to FM and phase modulation	CGTSF	1,964,373	18 Feb. 1931	26 June 1934
Lindenblad, Nils E.	Modulation	Transmitter only. Eliminates AM components from FM components and vice versa. Electronic modulation of "ultra-short-wave" oscillations.	RCA	1,938,749	27 Mar. 1931	12 Dec. 1933
Crosby, Murray G.	Reception of Phase Modulated Waves	Receiver only	RCA	2,114,335	25 Sept. 1931	19 Apr. 1938
Wolcott, Carl Frederick	Communication System		None	1,972,964	28 Sept. 1931	11 Sept. 1934
Crosby, Murray G.	Phase Modulation	Transmitter and receiver	RCA	2,081,577	23 Jan. 1932	25 May 1937
Crosby, Murray G.	Phase Modulation Receiver	Limits "the frequency band of the receiver to the band occupied by the signal. This results in minimum noise and interference."	RCA	2,101,703	23 Jan. 1932	7 Dec. 1937
Crosby, Murray G.	Frequency or Phase Modulation	Transmitter only	RCA	2,085,739	30 Apr. 1932	6 July 1937



Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Roostenstein, Hans Otto	Modulation	Transmitter only. High-speed modulation.	TGFDT	2,001,891	5 May 1932	21 May 1935
Hansell, Clarence W.	Signaling	Transmitter and receiver. Antifading.	RCA	1,999,902	13 May 1932	30 Apr. 1935
Usselman, George Lindley	Phase and Frequency Modulation	Transmitter only. Antifading.	RCA	2,036,165	8 June 1932	31 Mar. 1936
Crosby, Murray G.	Signal Receiver	FM and phase modulation	RCA	2,229,640	20 June 1932	28 Jan. 1941
Crosby, Murray G.	Signal Receiver	FM and phase modulation	RCA	2,230,212	20 June 1932	28 Jan. 1941
Crosby, Murray G.	Frequency Modulation	Transmitter only. Push-pull oscillator.	RCA	2,032,403	9 July 1932	3 Mar. 1937
Hansell, Clarence W.	Electrical Circuits	Transmitter only. Elimination of amplitude modulation in a phase modulation or FM system.	RCA	1,999,190	31 Oct. 1932	30 Apr. 1935
Conklin, James W.	Frequency Modulation	Transmitter only. Magnetron oscillator, followed by amplitude limiter.	RCA	1,965,332	17 Dec. 1932	3 July 1934
Turner, Alfred H.	Secret Signaling	Transmitter only	RCA	2,026,758	21 Dec. 1932	7 Jan. 1936
Lindenblad, Nils E.	Short Wave Signaling	Transmitter only	RCA	2,052,888	14 Jan. 1933	1 Sept. 1936
Conklin, James W.	Receiver	Phase modulation and FM	RCA	2,091,271	17 Jan. 1933	31 Aug. 1937
Armstrong, Edwin H.	Radiosignaling	Wideband FM	None	1,941,068	24 Jan. 1933	26 Dec. 1933
Armstrong, Edwin H.	Radiosignaling	Wideband FM	None	1,941,069	24 Jan. 1933	26 Dec. 1933
George, Ralph W.	Receiving Means	Carrier frequencies of 70 cm (428 mc). Uses IF amplifier 600 kilocycles wide, "of sufficient width to make its use in television desirable."	RCA	2,035,745	27 Apr. 1933	31 Mar. 1936

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Philpott, La Verne R.	Facsimile Transmission System	Transmitter only	WEM	2,070,312	21 June 1933	9 Feb. 1937
Hansell, Clarence W.	Variable Reactance Modulator Circuit	Rapid modulation of FM and phase modulation systems	RCA	2,121,737	24 July 1933	21 June 1938
Usselman, George Lindley	Frequency Modulation Apparatus	Transmitter only	RCA	2,030,125	25 Sept. 1933	11 Feb. 1936
Bechmann, Rudolf, and Elstermann, Herbert	Frequency Modulation	Transmitter only	TGFDT	2,076,289	10 Nov. 1933	6 Apr. 1937
Lindenblad, Nils E.	Modulation	Transmitter only. "Used in the transcontinental test between Bolinas and Riverhead."	RCA	2,054,431	29 Nov. 1933	15 Sept. 1936
Chaffee, Joseph G.	Modulating System for Ultra Short Waves	Transmitter only. Adaptable for FM.	BTL	2,038,992	15 Dec. 1933	28 Apr. 1936
Crosby, Murray G.	Receiving System	Phase modulation and FM	RCA	2,060,611	23 Dec. 1933	10 Nov. 1936
Crosby, Murray G.	Receiver	Receiver only. FM, AM, or phase modulation.	RCA	2,064,106	27 Dec. 1933	15 Dec. 1936
Crosby, Murray G.	Frequency Modulation Phase Modulation Receiver	Receiver only	RCA	2,112,881	28 Dec. 1933	5 Apr. 1938
Conklin, James W.	Frequency Modulation Detection		RCA	2,095,314	23 Mar. 1934	12 Oct. 1937

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Crosby, Murray G.	Phase and Amplitude Modulation Receiver		RCA	2,019,446	9 Apr. 1934	29 Oct. 1935
Crosby, Murray G.	Phase and Frequency Modulation Wave Receiving System		RCA	2,087,429	6 June 1935	20 July 1937
Armstrong, Edwin H.	Radio Transmitting System		None	2,063,074	14 Sept. 1935	8 Dec. 1936
Armstrong, Edwin H.	Radio Transmitting System		None	2,098,698	14 Sept. 1935	9 Nov. 1937
Armstrong, Edwin H.	Radio Signaling System		None	2,104,011	14 Sept. 1935	4 Jan. 1938
Armstrong, Edwin H.	Multiplex Radio Signaling System		None	2,104,012	14 Sept. 1935	4 Jan. 1938
Armstrong, Edwin H.	Radio Receiving System		None	2,116,501	14 Sept. 1935	10 May 1938
Conrad, Frank	Receiving System	Simultaneous AM and FM reception	WEM	2,151,747	14 Sept. 1935	28 Mar. 1939
Usselman, George Lindley	Oscillation Generator and Frequency Modulator		RCA	2,160,466	5 Oct. 1935	30 May 1939
Crosby, Murray G.	Detection of Frequency Modulated Signals		RCA	2,071,113	17 Oct. 1935	16 Feb. 1937
Seeley, Stuart William	Frequency Variation Response Circuits	Applicable to FM detection	RCA	2,121,103	17 Oct. 1935	21 June 1938
Roberts, Walter van B.	Electric Phase Controlling Circuit		RCA	2,215,127	9 Nov. 1935	26 July 1938
Chaffee, Joseph G.	Receiving System for Frequency Modulated Waves		BTL	2,118,161	24 Dec. 1935	24 May 1938

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Chaffee, Joseph G.	Reception of Frequency Modulated Waves		BTL	2,075,503	26 Mar. 1936	30 Mar. 1937
Armstrong, Edwin H.	Radio Receiving System		None	2,116,502	25 Aug. 1936	10 May 1938
Hansell, Clarence W.	Frequency Modulation Circuits	Improved balanced receiver	RCA	2,179,182	27 Nov. 1936	7 Nov. 1939
Bown, Ralph	Frequency Modulation		BTL	2,212,338	28 Apr. 1938	20 Aug. 1940
Chaffee, Joseph G.	Radio Repeater	Improved repeaters for FM	BTL	2,148,532	28 Apr. 1938	28 Feb. 1939
Roder, Hans	Frequency Modulation System	Allows a weaker signal to break into a stronger signal	GE	2,270,899	12 Nov. 1938	27 Jan. 1942
Armstrong, Edwin H.	Means and Method for Relaying Frequency Modulated Signals		None	2,264,608	12 Jan. 1940	2 Dec. 1941
Armstrong, Edwin H.	Radio Rebroadcasting System		None	2,276,008	12 Jan. 1940	10 Mar. 1942
Armstrong, Edwin H.	Frequency Modulation System		None	2,290,159	12 Jan. 1940	21 July 1942
Armstrong, Edwin H.	Means for Receiving Radio Signals		None	2,318,137	12 Jan. 1940	4 May 1943
Armstrong, Edwin H.	Frequency-Modulated Carrier Signal Receiver		None	2,540,643	12 Jan. 1940	6 Feb. 1951
Armstrong, Edwin H.	Current Limiting Device		None	2,295,323	2 Aug. 1940	8 Sept. 1942
Armstrong, Edwin H.	Method and Means for Transmitting Frequency Modulated Signals		None	2,315,308	2 Aug. 1940	30 Mar. 1943

Inventor	Title	Notes	Assignee	Patent No.	Application Date	Issue Date
Armstrong, Edwin H.	Means and Method for Relaying Frequency Modulated Signals		None	2,275,486	25 Sept. 1940	10 Mar. 1942
Roberts, Walter van B.	Frequency Modulation		RCA	2,289,041	10 Oct. 1940	7 July 1942
Armstrong, Edwin H.	Frequency Modulation Signaling System		None	2,323,698	12 Oct. 1940	6 July 1943
Armstrong, Edwin H.	Radio Signaling		None	2,602,885	30 Mar. 1946	8 July 1952
Armstrong, Edwin H.	Frequency Modulation Multiplex System		None	2,630,497	1 June 1949	3 Mar. 1953