DEPARTMENT OF COMMERCE

RADIO · SERVICE BULLETIN

ISSUED MONTHLY BY BUREAU OF NAVIGATION

Washington, December 31, 1925—No. 105

CONTENTS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name = Name of station.
Loc. = Geographical location. O = west longitude. N = north latitude. S = south latitude.
Call = Call letters assigned.
System = Radio system used and sparks per second.
Range = Normal range in nautical miles.
W. l. = Wave lengths assigned; normal wave lengths in italics.
Service = Nature of service maintained.
- FX = Point-to-point (fixed service).
- PG = General public.
- PR = Limited public.
- RC = Radiocompass station.
- FS = Fog signal.
- P = Private.
- O = Government business exclusively.

Hours = Hours of operation.
- N = Continuous service.
- X = No regular hours.

F. T. Co. = Federal Telegraph Co.
I. R. T. Co. = Intercity Radio Telegraph Co.
I. W. T. C. = Independent Wireless Telegraph Co.
K. & C. = Kilbourne & Clark Manufacturing Co.
R. C. A. = Radio Corporation of America.
U. R. Corp. = Universal Radio Corporation.
W. S. A. Co. = Wireless Specialty Apparatus Co.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
Kc. = Kilocycles.
Fy. = Frequency.
A. c. = Alternating current.
V. t. = Vacuum tube.
U. S. L. = After operating company denotes that the change applies only to the List of Radio Stations of the United States.

NOTE.—Beginning with this edition this publication will be dated the last day

NEW STATIONS

Commercial ship stations, alphabetically by names of vessels

[Additions to the List of Radio Stations of the United States, edition of June 30, 1925, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Name of vessel	Call signal	Rates	Service	Hours	Owner of vessel	Station controlled by—
Brandon	KFYL	.....	PG	X	Rutland-Lake Michigan Transit Co.	I. W. T. Co.
E. G. Crosby	WJP	8	PG	N	Wisconsin & Michigan Transportation Co.	R. C. A.
Henry W. Breyer	KFYT	8	PG	X	New York-Florida Navigation Corporation.	
Indiana Harbor	KUBS	8	PG	X	Pillsbury & Curtis	Do.
Isonzo	KFZD	8	PG	X	Joseph F. O'Boyle	
Lake Benton	KSIU	8	PG	X	United States Shipping Board	I. W. T. Co.
Lake Capens	KLUA	8	PG	X	John B. Waterman	Do.
Lake Fernando	KELM	8	PG	X	Munson Steamship Co.	Do.
Lake Galata	KOJJ	8	PG	X	Merchants & Miners Transportation Co.	R. C. A.
Lake Getaway	KOLZ	8	PG	X	....do	Do.
Lake Gliteidge	KEBM	8	PG	X	Richard Walsh	I. W. T. Co.
Lake Glaucus	KUMV	8	PG	X	Merchants & Miners Transportation Co.	R. C. A.
Lake Medford	KZOA	8	PG	X	Lawrence Steamship Co.	Do
Lake Washburn	KREI	8	PG	X	....do	Do.
Mohawk	KFYU	8	PG	X	Clyde Steamship Co.	
O. A. Harmanson	WRA	8	PG	X	Cary-Davis Tug & Barge Co.	
Pawnee	KFZE	.....	.....	.....	Harry F. Bingham	
Peerless [1]	KFYV	8	PG	X	Wood Towing Corporation	Do.
Walucia	KFYZ	.....	.....	.....	H. D. Walbridge	I. W. T. Co.
West Conob	KIFP	8	PG	X	United States Shipping Board	R. C. A.
West Henshaw [2]	KEBQ	8	PG	X	....do	Do.

[1] Range, 100; system, R. C. A. v. t. telegraph; w. l., 600, 706, 750, 800, 900.
[2] Range, 300; system, Navy-K. & C., 1000; w. l., 600, 706, 800.

Commercial land and ship stations, alphabetically by call signals

[b, ship station; c, land station]

Call signal	Name of station		Call signal	Name of station	
KEBM	Lake Gliteidge	b	KLUA	Lake Capens	b
KEBQ	West Henshaw	b	KOJJ	Lake Galata	b
KELM	Lake Fernando	b	KOLZ	Lake Getaway	b
KFYL	Brandon	b	KREI	Lake Washburn	b
KFYT	Henry W. Breyer	b	KSIU	Lake Benton	b
KFYU	Mohawk	b	KUBS	Indiana Harbor	b
KFYV	Peerless	b	KUMV	Lake Glaucus	b
KFYZ	Walucia	b	KZOA	Lake Medford	b
KFZD	Isonzo	b	WJP	E. G. Crosby	b
KFZE	Pawnee	b	WRA	O. A. Harmanson	b
KIFP	West Conob	b			

Broadcasting stations, alphabetically by names of States and cities

[Additions to the List of Radio Stations of the United States, edition of June 30, 1925]

State and city	Call signal	State and city	Call signal
Alaska: Anchorage	KFQD	Texas:	
Nebraska: Clay Center	KMMJ	Amarillo	WQAC
Oklahoma: Oklahoma	KFXR	El Paso	WDAH
		Washington: Spokane	KFIO

Stations broadcasting market or weather reports, music, concerts, lectures, etc., alphabetically by call signals

Call signal	Location of station (address)	Owner of station	Power (watts)	Wave length	Frequency (kilocycles)
KFIO[1]	Spokane, Wash.	North Central High School	100	265.3	1,130
KFQD[1]	Anchorage, Alaska	Chovin Supply Co.	100	227.1	1,320
KFXR	Oklahoma, Okla., 152½ West Main Street.	Classen Film Finishing Co.	15	214.2	1,400
KMMJ	Clay Center, Nebr.	M. M. Johnson Co.	500	228.9	1,310
WDAH[1]	El Paso, Tex.	Trinity Methodist Church (South)	50	267.7	1,120
WQAC[1]	Amarillo, Tex.	Gish Radio Service	100	234.2	1,280

[1] Relicensed.

Special land stations, alphabetically by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1925]

Station	Call signal	Station controlled by—
Bozeman, Mont.	7XB	Montana State College.
Carterville, Mo.	9XV	Rev. Lannie W. Stewart.

Special land stations grouped by districts

Call signal	District and station	Call signal	District and station
7XB	Seventh district: Bozeman, Mont.	9XV	Ninth district: Carterville, Mo.

ALTERATIONS AND CORRECTIONS

COMMERCIAL LAND STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

BUFFALO, N. Y.—System, Navy-Simon spark, 1,000 and composite v. t. telegraph; hours, 6 a. m. to midnight.
CULVER CITY, CALIF.—W. l., 115.
DETROIT, MICH. (WDI).—Location (approximately) O 83° 03′ 00″, N 42° 20′ 00″.
HIALEAH, FLA.—W. l., *600*, 625, 2,175, 4,250, 4,759, 5,552.
Strike out all particulars of the following-named stations: Cleveland, Ohio (KDPM); Fairport, Va.; Tuckerton, N. J. (WGH).

COMMERCIAL SHIP STATIONS, ALPHABETICALLY BY NAMES OF VESSELS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

ABBECON.—System, Navy, 1,000; w. l., *600*, 706, 800.
AGWILAKE.—W. l., *600*, 706, 800.
AGWIMEX.—W. l., *600*, 706, 800.
AGWIMOON.—W. l., *600*, 706, 800.
AGWISEA.—W. l., *600*, 706, 800.
AGWISTAR.—System, Marconi, 1,000; w. l., *600*, 706, 800.
ALBERT E. WATTS.—W. l., add 800.
AMERICAN LEGION.—Owner of vessel, Munson Steamship Line.
ANSONIA.—Station controlled by I. W. T. Co.

BALLENAS.—Station controlled by R. C. A.
BANNACK.—W. l., *600*, 706, 800.
BATHALUM.—Range, 300; system, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900; owner of vessel, Ford Motor Co.
BELLEFLINE.—Station controlled by I. W. T. Co.
BOOBYALLA.—Station controlled by F. T. Co.
BURLINGTON.—Range, 100; system, R. C. A. v. t. telegraph; w. l., *600*, 706, *715*, 800, 875; rates, add North and South American and trans-Oceanic services, 8 cents per word.
CAROLINIAN.—W. l., *600*, 706, 800.
CASCADE (KDIS).—W. l., *600*, 706, 800.
CATHERINE D.—W. l., *600*, 706, 800.
CHICKASAW CITY.—W. l., *600*, 706, 800.
CIRCINUS.—System, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900.
CITY OF CLEVELAND III.—W. l., *715*, 800, 875.
CITY OF DALLAS.—Range, 200; system, Navy-Marconi, 1,000; w. l., *600*, 706, 800; station controlled by owner of vessel.
CLONTARF.—W. l., add 450.
COMMERCIAL COURIER.—Range, 300; system, Kilbourne & Clark, 1,000.
CORSAIR.—Station controlled by R. C. A.
CORSON.—Owner of vessel, Export Steamship Corporation.
CYTHERIA.—Correct orthography Cytherea; system, composite v. t. telegraph; w. l., *600*, 706, 800, 870; owner of vessel, Victor Girard Corporation.
DAKOTAN.—W. l., *600*, 706, 800.
DEEPWATER.—Name changed to Lemuel Burrows.
DEFACTO.—W. l., *600*, 706, 800.
DOYLESTOWN.—W. l., *600*, 706, 800; station controlled by owner of vessel.
DUNGANNON.—W. l., *600*, 706, 800.
EASTERN KNIGHT.—System, Navy, 1,000; w. l., *600*, 706, 800.
EASTERN SEA.—W. l., *600*, 706, 800.
EELBECK.—W. l., *600*, 706, 750, 800, 1,800, 1,900, 2,000, 2,100, 2,400.
EL CAPITAN (KILP).—W. l., *600*, 706, 800; rates, strike out Great Lakes rate; station controlled by owner of vessel.
ELISHA WALKER.—System, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900.
ELIZABETH.—W. l., *600*, 706, 800.
EL RIO.—Name changed to Brazos; owner of vessel, Mallory Steamship Co.; station controlled by I. W. T. Co.
EL SIGLO.—System, Marconi, 1,000; w. l., *600*, 706, 800.
EL SUD.—Name changed to Pecos; owner of vessel, Mallory Steamship Co.; station controlled by I. W. T. Co.
E. W. SINCLAIR.—W. l., *600*, 706, 800.
FIRMORE.—W. l., *600*, 706, 800.
FORDONIAN.—Range, 150; system, R. C. A., 1,000; w. l., *600*, 706, 800.
FREEMAN.—System, R. C. A. v. t. telegraph; w. l., *600*, 706, 800, 900.
GLENDARUEL.—System, Marconi, 1,000; w. l., *600*, 706, 800.
GOLIAH.—Range, 300; system, Navy-Lowenstein, 1,000; w. l., *600*, 706, 800.
GREYLOCK.—W. l., *600*, 706, 800, 1,800, 1,900, 2,000, 2,100, 2,400.
GULF PRINCE.—W. l., *600*, 706, 800.
HAGOOD.—W. l., *600*, 706, 800.
HAMILTON.—Owner of vessel, Eastern Steamship Lines.
HAMLIN F. MCCORMICK.—Station controlled by owner of vessel.
H. C. FOLGER.—W. l., *600*, 706, 800.
H. H. ROGERS.—System, R. C. A. v. t. telegram; w. l., *600*, 706, 750, 800.
HOMER.—Station controlled by R. C. A.
HUMRICK.—System, Navy-Marconi, 1,000; w. l., *600*, 706, 800; rates, strike out Great Lakes rate; owner of vessel, Ford Motor Co.
INDEPENDENCE.—Station controlled by R. C. A.
IOWAN.—W. l., *600*, 706, 800.
JACOX.—Station controlled by owner of vessel.
JAMESTOWN.—Owner of vessel, Eastern Steamship Lines.
J. E. O'NEIL.—W. l., *600*, 706, 800.
JOMAR.—W. l., add 800.
JOSEPH M. CUDAHY.—W. l., *600*, 706, 800.
LAKE ELLSBURY.—Owner of vessel, Munson Steamship Line.
LAKE FABYAN.—Name changed to Munleon; range, 300; system, R. C. A. v. t. telegraph; w. l., *600*, 706, 800; owner of vessel, Munson Steamship Line.
LA PERLA.—Range, 150; system, W. S. A. Co., 1,000; w. l., 600, 706, 800; station

LEXINGTON.—W. l., *600*, 706, 800, 875.
LIBERTY GLO.—Station controlled by R. C. A.
LUBRICO.—Station controlled by F. T. Co.
LUXPALILE.—W. l., *600*, 706, 800.
MARQUETTE AND BESSEMER No. 2.—W. l., *715*, 875.
MEANTICUT.—System, add Navy spark, 1,000; w. l., *600*, 706, 800, 1,800, 2,100, 2,400.
MEMPHIS CITY.—W. l., *600*, 706, 800.
MENOMINEE.—Owner of vessel, Southern Transportation Co.
MERIDA.—W. l., add 706.
METEOR.—W. l., *600*, 706, 800; station controlled by R. C. A. (U. S. L.).
MICHARO.—Range, 500; system, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900, 1,800, 1,900, 2,100, 2,400.
MUNALBRO.—Owner of vessel, Munson Steamship Line.
NEW HAVEN.—Hours, N.
NOBLES.—Owner of vessel, Export Steamship Corporation.
NORLINA.—W. l., *600*, 706, 800.
OCCIDENTAL.—W. l., add 800.
PALLAS.—Name changed to S. A. Perkins.
PEERLESS (KFYV).—Range, 100; system, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900.
PETER KERR.—Station controlled by I. W. T. Co.
PIPESTONE COUNTY.—W. l., *600*, 706, 800.
PLYMOUTH (KXH).—Hours, N.
POINT JUDITH.—Station controlled by F. T. Co.
POINT LOMA.—W. l., *600*, 706, 800.
RELIEF.—W. l., *600*, 706, 800, 1,800, 2,100, 2,400.
RESOLUTE (KRM).—W. l., *600*, 706, 800.
SABINE SUN.—System, R. C. A., 1,000; w. l., *600*, 706, 800.
SAC CITY.—W. l., *600*, 706, 800.
SAGAPORACK.—W. l., *600*, 706, 800; station controlled by R. C. A.
SAMUEL Q. BROWN.—System, R. C. A. v. t. telegraph; w. l., *600*, 706, 750, 800, 900.
SAN JUAN (WWM).—Owner of vessel, James K. Nelson.
SARCOXIE.—W. l., add 800.
SATARTIA.—W. l., *600*, 706, 800.
SAUCON (WBK).—W. l., add 450.
SAUGUS.—Owner of vessel, Export Steamship Corporation.
SEA SCOUT.—W. l., *600*, 706, 800.
SEAWARD.—W. l., 115, *600*; service, P.
SEMINOLE.—System, add Lowenstein spark, 1,000; w. l., add 1,900, 2,000.
SHADOW K.—Owner of vessel, Clyde B. Hewes.
SHASTA.—W. l., *600*, 706, 800.
SIERRA (KFHM).—W. l., *600*, 706, 800.
SILVER SHELL.—W. l., *600*, 706, 800.
SOCONY 84.—W. l., *600*, 706, 800.
SOLITAIRE.—System, I. W. T. Co. arc and I. W. T. Co. spark, 1,000; w. l., *600*, 706, 800, 900, 1,800, 2,100, 2,400.
SOUTHERN CROSS.—Owner of vessel, Munson Steamship Line.
STUART DOLLAR.—W. l., *600*, 706, 800.
SUBOATCO.—W. l., *600*, 706, 800.
SUELCO.—W. l., *600*, 706, 800.
SUMANCO.—W. l., *600*, 706, 800.
SUTORPCO.—W. l., *600*, 706, 800.
THE LAMBS.—System, Navy-W. S. A. Co., 1,000; w. l., *600*, 706, 800.
TRADER.—Range, 150; system, Canadian Marconi, 1,000; w. l., *600*, 706, 800.
UNITED STATES.—W. l., *600*, 706; rates, North and South American and trans-oceanic services, 8 cents per word.
VICTORIOUS.—Station controlled by R. C. A.
WEST HOLBROOK.—System, Navy-Marconi, 1,000; w. l., *600*, 706, 800.
WEST JAPPA.—Owner of vessel, Oriental Navigation Co.; station controlled by R. C. A.
W. F. BURROWS.—W. l., *600*, 706.
WILDWOOD.—Station controlled by I. W. T. Co.
WM. ROCKEFELLER.—System, R. C. A. v. t. telegraph; w. l., *600*, 706, 800, 900, 1,800, 1,900, 2,000, 2,100, 2,400.
WINONA.—Owner of vessel, Export Steamship Corporation.

Strike out all particulars of the following-named vessels: Antilla, Baldrock, Boston (KXA), Buford, Commercial Trader, D. F. McAllister, Fred J. Wood, General G. W. Goethals, Johanna Smith, Katherine R., Lansing, Lenape, Mary E. Moore, Missouri (WFX), Nushagak, Rainier, San Pedro, Sierra (KRW).

COMMERCIAL LAND AND SHIP STATIONS, ALPHABETICALLY BY CALL SIGNALS

KINJ, *read* Lake Fabyan; KKQ, *read* Pecos; KKZ, *read* Brazos; KLY, *read* Lemuel Burrows; KUTJ, *read* S. A. Perkins; KYQ, *read* Cytheres; strike out all particulars following the call signals KDAH, KDPM, KEJT, KEQJ, KFII, KFKE, KFSZ, KMZ, KRW, KVL, KWD, KXA, WFX, WGH, WHZ, WMT, WNE, WRZ, WSF, WTC.

BROADCASTING STATIONS, BY CALL SIGNALS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925]

KFAU (Boise, Idaho).—W. l., 280.2, fy. kc., 1,070.
KFCF (Walla Walla, Wash.).—Call signal changed to KOWW; power, 500 watts; owner of station, Blue Mountain Radio Association (Frank A. Moore).
KFDJ (Corvallis, Oreg.).—Call signal changed to KOAC; w. l., 280.2, fy. kc., 1,070.
KFOB (Burlingame, Calif.).—Owner of station, KFOB (Inc.).
KFQB (Fort Worth, Tex.).—Power, 1,000.
KGO (Oakland, Calif.).—Power, 4,000.
KGTT (San Francisco, Calif.).—W. l., 206.8, fy. kc., 1,450.
KYW (Chicago, Ill.).—Power, 3,500.
WAAM (Newark, N. J.).—Call signal changed to WBPI.
WAGM (Royal Oak, Mich.).—W. l., 225.4, fy. kc., 1,330.
WBAL (Baltimore, Md.).—W. l., 245.8, fy. kc., 1,220.
WDWF (Cranston, R. I.).—Call signal changed to WDWF and WLSI; owner of station, Dutee W. Flint and Lincoln Studios (Inc.).
WEAH (Wichita, Kans.).—Call signal changed to KFH.
WEBK (Grand Rapids, Mich.).—Call signal changed to WOOD.
WGN (Chicago, Ill.).—W. l., 302.8, fy. kc., 990.
WJJD (Mooseheart, Ill.).—W. l., 370.2, fy. kc., 810.
WMAQ (Chicago, Ill.).—Power, 1000.
WNOX (Knoxville, Tenn.).—Power, 100.
Strike out all particulars following the call signals, KFBG (Tacoma, Wash.); KFRM (Fort Sill, Okla.); KFRY (State College, N. Mex.); KFVU (Eureka, Calif.); KFWP (Brownsville, Tex.); KFXE (Waterloo, Iowa); WCAH (Columbus, Ohio); WCBG (Pascagoula, Miss., portable); WCUW (Worcester, Mass.); WEBT (Dayton, Ohio); WGBQ (Menomonie, Wis.); WHAG (Cincinnati, Ohio); WHBR (Cincinnati, Ohio); WJD (Granville, Ohio); WLAX (Greencastle, Ind.); WOAC (Lima, Ohio); WPDQ (Buffalo, N. Y.); WTG Manhattan, Kans.).

GOVERNMENT LAND STATIONS, ALPHABETICALLY BY NAMES OF STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

CAPE HENRY, VA.—Loc. O 75° 59′ 54″, N 36° 55′ 20″; range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
CAPE LEWES, DEL.—Range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
CAPE MAY, N. J. (NCY).—Range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
GLOUCESTER, MASS.—Loc. O 70° 39′ 35″, N 42° 36′ 39″; range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
NEW LONDON, CONN. (NLO).—Loc. O 72° 05′ 31″, N 41° 21′ 36″; range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
ROCKAWAY BEACH, N. Y.—Loc. O 73° 52′ 52″, N 40° 33′ 49″; range, 50; system, Western Electric Co. v. t. telephone and telegraph; w. l., 130, 143.
WOODS HOLE, MASS.—Range, 50; system, Western Electric Co. v. t. telephone

GOVERNMENT SHIP STATIONS, ALPHABETICALLY BY NAMES OF STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

SAUKEE.—Owner of vessel, United States Coast Guard.
SEMINOLE.—Owner of vessel, United States Coast Guard (U. S. L.).
Strike out all particulars of the following-named vessels: Beaufort, S. C. 54.

GOVERNMENT LAND AND SHIP STATIONS, ALPHABETICALLY BY CALL SIGNALS

Strike out all particulars following the call signals, NGP, NODB.

SPECIAL LAND STATIONS, BY NAMES OF STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925]

OAKLAND, CALIF. (6XBN).—Strike out all particulars.

IMPORTANT EVENTS IN RADIO—PEAKS IN THE WAVES OF WIRELESS PROGRESS

1827. Savary found that a steel needle could be magnetized by the discharge from a Leyden jar.

1831. Farady discovered electromagnetic induction between two entirely separate circuits.

1837. The first patent for an electric telegraph was taken out by Cooke and Wheatstone (London) and by Morse (United States).

1838. Steinheil discovered the use of the earth return.

1840. Henry first produced high frequency electric oscillations and pointed out that the discharge of a condenser is oscillatory.

1842. Morse made wireless experiments by electric conduction through water.

1843. Lindsay suggested that if it were possible to provide stations not more than 20 miles apart all the way across the Atlantic there would be no need of laying a cable.

1845. Lindsay made experiments in transmitting messages across the River Tay by means of electricity or magnetism without submerging wires, using the water as a conductor.

1849. Wilkins revived the same suggestions for wireless telegraphy.

Dr. O'Shaughnessy succeeded in passing intelligible signals without metallic conduction across a river 4,200 feet wide.

1862. Heyworth patented a method of conveying electric signals without the intervention of any continuous artificial conductor.

1867. Maxwell read a paper before the Royal Society in which he laid down the theory of electromagnetism, which he developed more fully in 1873 in his great treatise on electricity and magnetism. He predicted the existence of the electric waves that are now used in wireless telegraphy.

1870. Von Bezold discovered that oscillations set up by a condenser discharge in a conductor give rise to interference phenomena.

1872. Highton made various experiments across the River Thames with Morse's method.

1879. Hughes discovered the phenomena on which depend the action of coherer. The coherer was later used practically by Marconi.

1880. Trowbridge found that signaling might be carried on over considerable distances by electric conduction through the earth or water between places not metallically connected.

1882. Bell's experiments with Trowbridge method on the Potomac River resulted in the detection of signals at a distance of 1½ miles.

Professore Dolbear was awarded a United States patent in March, 1882, for wireless apparatus in connection with which he made the statement that "electrical communication, using this apparatus, might be established between points certainly more than one-half mile apart, but how much farther I can not say." It appeared that Professor Dolbear made an approach to the method that was, subsequently in the hands of Marconi, to be crowned with success.

1883. Fitzgerald suggested a method of producing electromagnetic waves

1885. Edison, assisted by Gilliland, Phelps, and Smith, worked out a system of communication between railway stations and moving trains by means of induction and without the use of conducting wires. Edison took out only one patent on long-distance telegraphy without wires. The application was filed May 23, 1885, at the time he was working on induction telegraphy, but the patent (No. 465971) was not issued until December 29, 1891. In 1903 it was purchased from him by the Marconi Wireless Telegraph Co.

Preece made experiments at Newcastle-on-Tyne which showed that in two completely insulated circuits of square form, each side being 440 yards, placed a quarter of a mile apart, telephonic speech was conveyed from one to the other by induction.

1886. Dolbear patented a plan for establishing wireless communication by means of two insulated elevated plates, but there is no evidence that the method proposed by him did, or could, effect the transmission of signals between stations separated by any distance.

1887. Hertz showed that electromagnetic waves are in complete accordance with the waves of light and heat, and founded the theory upon which all modern radio signaling devices are based.

Heaviside established communication by telephonic speech between the surface of the earth and the subterranean galleries of the Broomhill Collieries, 350 feet deep, by laying above and below ground two complete metallic circuits, each about 2¼ miles in length, and parallel to each other.

1889. Thompson suggested that electric waves were particularly suitable for the transmission of signals through fogs and material objects.

1891. Trowbridge suggested that by means of magnetic induction between two separate and completely insulated circuits communication could be effected between distances.

1892. Preece adopted a method which united both conduction and induction as the means of affecting one circuit by the current in another. In this way he established communication between two points on the Bristol Channel and at Lochness in Scotland.

Stevenson, of the Northern Lighthouse Board, Edinburgh, advocated the use of an inductive system for communication between the mainland and isolated lighthouses.

Branly devised an appliance for detecting electromagnetic waves, which was known as a coherer.

1894. Rathenau experimented with a conductive system of wireless telegraphy and signaled through 3 miles of water.

1895. Smith established communication by conduction with the lighthouse on the Fastnet.

Marconi's investigations led him to the conclusion that Hertzian waves could be used for telegraphing without wires.

1896. Marconi lodged his application for the first British patent for wireless telegraphy. He conducted experiments in communicating over a distance of 1¾ miles successfully.

The first demonstration of directional wireless using reflectors was given in England. Experiments were conducted to determine the relative speed of propagation of light waves and the electric vibrations which actuated a receiver at a distance of 1½ miles between reflectors.

1897. March: Marconi demonstrated communication being established over a distance of 4 miles.

March 17: Balloons were first used for the suspension of wireless aerials.

July 10–18: Marconi maintained communication between the shore and a ship at sea at distances up to 10 miles.

September and October: Apparatus was erected at Bath, England, and signals received from Salisbury, 34 miles distant.

November 1: First Marconi station erected at the Needles, Alum Bay, Isle of Wight. Experiments were conducted covering a range of 14½ miles.

December 6: Signals transmitted from shore to a ship at sea, 18 miles distant.

December 7: First floating wireless station was completed.

1898. June 3: The first paid radiogram was transmitted from the Needles (Isle of Wight) station.

July 20–22: Events of the Kingstown regatta in Dublin reported by wireless for Dublin newspaper from steamer *Flying Huntress*.

1899. April 22: The first French gunboat was fitted with wireless telegraph

July: During the naval maneuvers three British warships equipped with Marconi apparatus interchanged messages at distances up to 74 nautical miles (about 85 land miles).

The international yacht races which took place in September and October were reported by wireless telegraphy for the New York Herald. At the conclusion of the races series of trials were made between the United States cruiser *New York* and the battleship *Massachusetts*, signals being exchanged between the vessels at distances up to 36 miles. On the return journey from America Marconi fitted the steamship *St. Paul* with his apparatus, and on November 15 established communication with the Needles station when 36 miles away. Reports of the progress of the war in South Africa were telegraphed to the vessel and published in a leaflet entitled "The Transatlantic Times," printed on board.

1900. February 18: The first German commercial wireless station was opened on Borkum Island.

February 28: The first German liner fitted with wireless apparatus communicated with Borkum Island over a range of 60 miles.

November 2: The first wireless land station in Belgium was finished at Lapanne. Between 1900 and 1905 Doctor De Forest was granted numerous patents in the United States and other countries for inventions connected with wireless telegraphy.

1901. January 1: The bark *Medora* was reported by wireless as waterlogged on Ratel Bank. Assistance was immediately sent.

January 19: The *Princesse Clementine* ran ashore, and news of the accident was telegraphed to Ostend by wireless.

February 11: Communication was established between Niton Station, Isle of Wight, and the Lizard station, a distance of 196 miles.

March 1: A public wireless telegraph service was inaugurated between the five principal islands of the Hawaiian group, viz, Oahu, Kauai, Molaki, Maui, and Hawaii.

October 15: The first fan aerials were erected for experiments between Poldhu and Newfoundland.

December 12: The letter "S" was received by Marconi from Poldhu, England, at St. Johns, Newfoundland, a distance of 1,800 miles.

Prof. R. A. Fessenden applied for United States patent on September 28 for "Improvements in apparatus for the wireless transmission of electromagnetic wave, said improvements relating more especially to the transmission and reproduction of words or other audible signals." It appears that in connection with this apparatus there was contemplated the use of an alternating-current generator having a frequency of 50,000 cycles per second. Professor Fessenden was granted a number of United States patents between 1899 and 1905 covering devices used in connection with radiotelegraphy.

1901–1904. During this period Dr. John Stone was granted more than 70 United States patents covering radiotelegraphy.

1901–1905. More than 40 United States patents were granted to Harry Shoemaker covering certain apparatus used for radio communication.

1902. February: Steamship *Philadelphia*, American Line, received messages a distance of 1,551½ statute miles and received Morse signals up to a distance of 2,099 statute miles from Poldhu station, Cornwall, England.

June 25: The first moving wire magnetic detector actuated by clockwork was installed on the Italian cruiser *Carlo Alberto*.

July 14–16: Marconi received messages from Poldhu on the Italian cruiser *Carlo Alberto*, lying at Cape Skagen, a distance of 800 miles; and at Kronstadt, 1,600 miles.

December: On the 17th the first wireless message was transmitted across the Atlantic. On the 18th wireless messages were dispatched from Cape Breton station to King Edward VII.

1903. January 19: President Roosevelt sent a trans-Atlantic radiogram to King Edward via Cape Cod and Poldhu stations.

March 30: First transoceanic radiogram was published in the London Times.

August 4: First International Radiotelegraphic Conference was held at Berlin.

Poulsen patented the improved arc oscillation generator, using a hydrocarbon atmosphere and a magnetic field.

1904. January 20: The first press message was transmitted across the Atlantic.

August 15: The wireless telegraph act of Great Britain was passed.

November 16: Dr. J. Ambrose Fleming took out his original patent No. 24850 for thermionic valves.

1905. In October of this year erection of Clifden, Ireland, high-power radio station was commenced.

1906. Doctor De Forest was granted a patent on January 18 for a vacuum rectifier, commercially known as the audion.

Second International Radiotelegraphic Convention was held at Berlin, and a convention was signed by a majority of the principal countries of the world.

Dunwoody discovered the rectifying properties of carborundum crystals and Pickard discovered the similar properties of silicon crystals. These discoveries formed the basis of the widely used crystal detectors.

1907. October 17: Trans-Atlantic stations at Clifden and Glace Bay were opened for limited public service.

1908. February 3: Trans-Atlantic radio stations were opened to the general public for the transmission of messages between the United Kingdom and the principal towns in Canada.

In carrying out his invention Professor Fessenden constructed a high-frequency alternator with an output of 2.5 kilowatts at 225 volts and with a frequency of 70,000 cycles per second. Later Professor Fessenden reported successful wireless telephonic communication between his station located at Brant Rock, Mass., and Washington, D. C., a distance of about 600 miles.

1909. The steamship *Republic*, after colliding with the steamship *Florida* off the coast of the United States on January 23, succeeded in calling assistance by wireless, with the result that all her passengers and crew were saved before the vessel sank.

1910. The steamship *Principessa Mafalda* received messages from Clifden at a distance of 4,000 miles by day and 6,735 miles by night. On April 23 the Marconi Transatlantic (Europe-America) service was opened.

June 24: Act approved by the United States Government requiring radio equipment and operators on certain passenger-carrying vessels.

1911. July 1: Radio service organized in Department of Commerce and Labor to enforce the act of June 24, 1910.

1912. F. A. Kolster, of the Bureau of Standards, invented and developed the Kolster decremeter, which is used to make direct measurements of wave length and logarithmic decrement. This instrument has been used by the radio service of the Department of Commerce since it was invented.

Early in the year the American Marconi Co. absorbed the United Wireless Co., of the United States.

In February the Marconi Co. procured the patents of Bellini and Tosi, including those for the wireless direction finder.

On February 9 the Australian Commonwealth station was opened.

On April 15 the steamship *Titanic* on her maiden voyage, struck an iceberg and sank, but, owing to the prompt wireless call for assistance, the lives of more than 700 of her passengers were saved.

The International Radiotelegraphic Conference opened in London on June 4 and approved important regularions to have uniformity of practice in wireless telegraph services. On July 5 the International Radiotelegraphic Convention was signed at London.

July 23: Act approved by the United States Government extending act of June 24, 1910, to cover cargo vessels and requiring auxiliary source of power, efficient communication between the radio room and the bridge, and two or more skilled radio operators in charge of the apparatus on certain passenger-carrying vessels.

August 13: Act approved by the United Government licensing radio operators and transmitting stations.

1913. F. A. Kolster submitted to the Government a paper pointing out the advantages of certain applications of radio signaling for use at lighthouses, lightships, and life-saving stations, especially in time of fog.

During this year the Governments of France and the United States experimented between the Eiffel Tower station and Washington by wireless to procure data for comparing the velocity of electromagnetic waves with that of light.

In June a wireless telegraph bill was presented to the Ottawa Parliament and passed under the title "Radiotelegraph act of Canada."

On October 11 the *Volturno* was burned in mid-Atlantic, and in response to the wireless appeal 10 vessels came to the rescue, 521 lives being saved.

On November 24 the first practical trials with wireless apparatus on trains

The station at Macquerie Island was the means of keeping Doctor Mauson the Australian explorer, in touch with the outer world. Radio dispatches were published in a small journal which was established, called the Adelie Blizzard.

November 12: Safety at Sea Conference held in London. At this conference the use of radio received appropriate consideration.

November 24. The first practical trials with wireless apparatus on trains were made, messages having been received and transmitted on board trains.

1914. Experiments in wireless telephony were carried out between several vessels lying at anchor five-eighths of a mile apart, ordinary receivers being used with success. The wireless telephone experiments were continued between two warships on the high seas, and the reception was consistently good over a distance of 18½ miles. Successful wireless telephone communications were effected later, using only very limited energy between vessels on the high seas 44 miles apart. These experiments were repeated where land intervened between the communicating vessels, and in this case again excellent results were obtained. On this day radiotelephonic communication was constantly maintained for 12 hours.

On April 15, at Godalming, a memorial was unveiled to the memory of Jack Philips, chief radio operator of the ill-fated *Titantic*, who died at his post when the vessel foundered in mid-Atlantic on the 15th of April, 1912.

A new departure in the application of radiotelegraphy to the safety of life at sea was the equipment of the motor lifeboats of the steamship *Aquitania* with radio apparatus.

High-powered transoceanic stations were completed at Carnarvon, Wales, Belmar, Honolulu, and San Francisco during the autumn of 1914. The Honolulu-San Francisco stations were opened to public service September 24. The Tuckerton-Eilvese and Sayville-Nauen stations were in operation about this time.

Most of these stations made use of the latest developments in the art, using undamped and long waves as produced by the Poulsen arc and the radiofrequency alternator.

On October 6 E. H. Armstrong was issued a patent covering the regenerative circuit also known as the feed-back and the self-heterodyne circuit.

1915. During this year F. A. Kolster, of the Bureau of Standards, developed a radiocompass said to be more effective than that which was being used.

On February 20 the Panama-Pacific Exhibition at San Francisco was officially opened by President Wilson at Washington, through the medium of wireless telegraphy.

On May 12, in Battery Park, New York City, the mayor unveiled the monument in memory of wireless operators who had lost their lives at the post of duty.

On July 27 wireless communication between the United States and Japan was effected. Two terminal stations were located at San Francisco and Funabashi, near Tokyo, and the messages were relayed through Honolulu.

On July 28 the American Telephone & Telegraph Co., working in conjunction with the Western Electric Co., succeeded in telephoning the wireless across the American continent from Arlington to Hawaii, a distance of nearly 5,000 miles.

On October 26 the wireless telephone experiments were continued, communication being effected across the Atlantic from Arlington to the Eiffel Tower, Paris.

During this year ship service was greatly improved through the installation of new equipment, embodying features of great practical value, by various operating companies. Efficient emergency radio transmitters came into wider use, owing considerably to the efforts of the radio service of the Department of Commerce and its refusal to pass inefficient equipment. Such installations considered as essential are safeguards to shippers and the seagoing public.

1916. During the course of a severe blizzard in the United States during February wireless telegraphy was extensively used for train dispatching, as the telegraph wires were down.

The determination of the difference in longitude between Paris and Washington with the aid of radio which had been in progress since October, 1913, was completed during May, the result, expressed in terms of time, being 5 hours 17 minutes 35.67 seconds, and has a probable accuracy of the order of 0.01 second.

The initiation of the newly established trans-Pacific wireless service between the United States and Japan was celebrated on November 5, by an interchange of messages between the Mikado and President Wilson.

1917. June 2 marked the "coming of age" of wireless telegraphy in England; that is, that 21 years had elapsed since the registration of patent 12039 in 1896.

1918. The trend of progress toward continuous-wave communication as distinct from that by damped waves was very marked during this year, a particular [illegible] being given by the continued development of the electron tube as an

efficient receiver and generator of undamped oscillations. Steady improvement was also evident in the arc form of generator which was installed in many new high-power stations.

Wireless telephony also progressed to a marked extent, particularly in the direction of reliability and increase of range, due mainly to the development of valve generator and receivers.

In the equipment of aircraft with wireless great progress was made, both in radiotelegraphy and radiotelephony.

At the end of the year a high-power station, erected by the United States Government, was opened at Croix d'Hins, near Bordeaux.

In the Argentine the erection of a station destined for direct communication with the North American continent was commenced in the vicinity of Buenos Aires.

The extension in the application of wireless telegraphy to merchant vessels continued, and at the close of the year some 2,500 to 3,000 vessels of the British Merchant Marine carried installations.

On July 31 the United States Government took over all wireless land stations in the United States, with the exception of certain high-power stations, which remained under the control of commercial companies.

On September 22 messages transmitted from Carnarvon were received in Sydney, 12,000 miles away. Cable confirmations of these messages were sent forward at the same time, but were received some hours later than the corresponding radiotelegrams.

In April a high-power station was opened at Stavanger, Norway, for the use of the Norwegian Government. The station communicates with the United States.

1919. The successful transatlantic flights of Alcock and Brown, of the American *NC4*, and of the British dirigible *R34* during the summer of the year focused attention upon the application of radio for aviation purposes and its great value for aerial navigation.

On June 30, 1919, there were 2,312 ship stations of the United States, having increased from 1,478 on June 30, 1918. At this time new ship stations were increasing at the rate of 100 a month. This increase was due to the great number of vessels built during the war period.

The temporary war measures relative to the installation of wireless telegraph apparatus on all merchant vessels of 1,600 tons or over under the British flag was made permanent by a bill passed by the British Parliament.

In February a Spanish decree was issued to the effect that all sailing vessels of 500 tons or over and carrying 50 or more passengers must be equipped with wireless apparatus.

During the year the Radio Corporation took over the radio interests of the American Marconi Co.

The war-time ban on private and experimental wireless stations was removed.

1920. The steady development of continuous-wave wireless work was continued during the year and some further progress made in the commercial application of tube apparatus.

On January 14 a law was passed in Greece making the carrying of wireless apparatus obligatory on all Greek merchant ships of 1,600 tons gross and over, or having 50 or more persons abroad, including crew.

On January 25 a new high-power station was opened at Monte Grande, Argentine, call letters LPZ.

Amateur radio work in this and other countries progressed steadily during the year with the gradual removal of wartime restrictions.

Bordeaux, France, high-power station opened.

1921. Experiments were carried out in France with successful results in the application of Baudot and similar high-speed telegraph apparatus to radio work.

The Noble Prize for physics was awarded this year to Prof. Edouard Branly for his researches in radio.

The progress made in amateur and experimental wireless is exemplified by the attempts made in February and December of this year to effect communication on short-wave lengths between the wireless amateurs of the United States and Great Britain. The first attempt was unsuccessful, but during the second test signals from many American amateur stations were heard both by British radio amateurs and by the representative of the American Radio Relay League who was sent over for the tests. The signals were also heard in Holland.

The American Radio Relay League held its first annual convention in Chicago, August 30-September 8, at which many thousands of amateurs of the United

The first licenses for broadcasting stations were issued in September of this year. New York radio central station opened on Long Island.

1922. During this year broadcasting stations increased rapidly in keeping with the great interest taken in the art.

First Annual Radio Conference held in Washington, D. C., February 27.

On June 7 E. H. Armstrong read a paper before the Institute of Radio Engineers on some recent developments by him of regenerative circuits. Professor Armstrong was granted a patent for the superregenerative circuit.

Experiments in radiotelephony from ship to shore were conducted during this year. In tests from the steamship *America* it was proved possible to communicate with land telephone stations more than 400 miles distant from the ship.

1923. On March 2 L. A. Hazeltine, of Stevens Institute of Technology, presented a paper before the Radio Club of America on tuned radio-frequency amplification with neutralization of capacity coupling. Professor Hazeltine was granted a patent for the nonradiating neutrodyne receiver.

On March 4 the Cleveland, Ohio (KDPM), station of the Westinghouse Electric & Manufacturing Co. successfully repeated short waves from the East Pittsburgh, Pa. (KDKA), station for the first time in history.

Second Annual Radio Conference held in Washington, D. C., March 20.

The Marconi Co. made a tender, which was accepted, for the erection of a transmitting station in Australia of a power of 1,000 kilowatts with 20 steel masts, 800 feet high. Corresponding stations were to be provided in England and Canada. The receiving arrangements would permit simultaneous reception from five stations.

The construction of a large radio station in a valley between the Herzogstand and the Stein, two of the foothills in the Bavarian Alps, was undertaken. The aerial will be suspended by wire cables stretched between the tops of the two hills, the aerial wires being suspended from these cables.

The increase in traffic on some of the large liners of the Atlantic route led to the installation of apparatus for high-speed automatic transmission and reception on several lines.

Successful tests on wireless-controlled airplanes were carried out at the Etampes Aerodrome in France. Flights were made without a pilot. Flights were also made with a pilot using a gyroscopic stabilizer and special steering motors which could be controlled from the ground.

The International Commission for Aerial Navigation agreed, as a general principle, that all aircraft engaged in public transport must carry radio apparatus.

The General Electric Co. developed a tube capable of delivering 20 kilowatts of high-frequency energy to an aerial. Using six of these tubes in parallel with 15,000 volts on the anode, a current of 310 amperes in an Alexanderson multiple tuned aerial was obtained. A tube of the magnetron type was developed by the same company, capable of giving 1,000 kilowatts at 20,000 cycles with an efficiency of 70 per cent.

Great progress was made during the year in the development of vacuum tubes.

Short-wave lengths were used to greater advantage than heretofore.

The McMillan expedition to the polar regions had radio for their only means of direct communication. Using low power and short-wave lengths, their vessel, *Bowdoin*, communicated with several stations in the United States while they were frozen in thousands of miles away. Broadcasting concerts from United States stations were heard during the long dark nights of the Arctic Zone.

During the year foreign countries became interested in radiotelephone broadcasting.

Broadcasting in the United States heard in England. British stations also heard in the United States.

On December 31 East Pittsburgh, Pa. (KDKA), transmitted a program to Great Britain on a short wave.

1924. In January radio was used in the region of the Great Lakes during a blizzard for dispatching trains.

The high-power station at Monte-Grande, Argentina, was opened in January for direct communication with New York, Paris, and Berlin. The service will be extended to Great Britain when a corresponding transmitting station is available. The power of the station is 800 kilowatts, the aerial being carried on 10 masts, each 690 feet high. The receiving station is at Villa Eliza, 30 kilometers from Buenos Aires, the actual control being effected from a central office in Buenos

On February 5 a radio program broadcasted in the United States from the East Pittsburgh, Pa. (KDKA), station of the Westinghouse Electric & Manufacturing Co. was received and rebroadcast in England for the benefit of English stations.

On February 23 a concert broadcast by the same station and relayed from London, England, was heard clearly in Calcutta, India.

In July an agreement was concluded between the British Government and the Marconi Wireless Telegraph Co. (Ltd.) for the construction of a wireless station on the beam system, capable of communicating with Canada and of being extended to India, South Africa, and Australia, the transmitting station to have an input of at least 20 kilowatts and the receiving station to have an aerial designed to focus the received waves within an angle of 30°.

The short-wave direction system of radiotelegraphy and the results obtained in tests made on it were described in a lecture before the Royal Society of Arts, in July, by Senatore Marconi.

During the period from August 5 to September 24 the East Pittsburgh, Pa. (KDKA), station maintained communication with the ship *Arctic* while on its expedition to the Arctic regions. Upon the ship's return it was reported that messages sent on short waves by the East Pittsburgh station were received at Cape Sabine within 11° of the North Pole. This is the farthest north radio messages have been received.

On October 11 signals from the East Pittsburgh station were successfully repeated from a station in Cape Town, Africa.

Third National Radio Conference held in Washington, D. C., October 6.

An expedition from the United States, under the leadership of Hamilton Rice, which will explore the Amazon and Orinoco Rivers in Brazil and Venezuela, in the interest of geographical sciences in general, will have radio as their only means of communication.

Roger Babson, economist, estimates that during this year the American people will spend approximately $350,000,000 for radio equipment. Sales of radio equipment are running nearly twice as large as all kinds of sporting goods.

A wireless lighthouse has been set up on an island in the Firth of Forth, Scotland. Wireless waves are concentrated by reflectors into a beam which can be sent 100 miles, giving ships their position in a fog.

1925. Considerable progress was made during 1925 in working with short waves. Several transoceanic stations are working foreign stations at great distances on wave lengths varying from 22 to 103 meters.

In an experiment between the Hastings (Nebr.) station and the East Pittsburgh (Pa.) station the Westinghouse Electric & Manufacturing Co. demonstrated that a 64-meter wave could be picked up, and by placing it on a short transmission line to the transmitting station, increasing the strength of the signals to their original power or greater, if necessary, the amplified wave could be transmitted onward. This experiment shows that repeater stations can be constructed in different parts of the world and be fairly certain of transmitting a strong signal.

A number of short-wave transmissions were made by East Pittsburgh (KDKA) transmitting to South Africa and Australia.

Amateur operators by their interest have made considerable achievements in the development of short waves.

During July programs were broadcast to the American naval fleet in Australian waters.

Radiocompass (direction finder) came into greater use on board vessels. Over 100 American vessels are equipped.

The Lighthouse Service, Department of Commerce, established several new radio fog signal stations on all coasts of the United States.

The practical use of the telephone and radio for the transmission of photographs was more clearly demonstrated during the year.

As a means of eliminating interference, the transmitters of high-powered broadcasting stations were moved to the outlying districts of several large cities, the studios remaining in the cities.

Broadcasting programs from airplanes was done in a few instances.

The General Electric Co., the Radio Corporation of America, and the Westinghouse Electric & Manufacturing Co. conducted experiments in broadcasting, using as high as 50 kilowatts.

The Department of Commerce placed in commission a "radio test car" which is equipped with an assortment of radio instruments used in conducting tests

The Fourth National Radio Conference was held in Washington, D. C., November 9, 1925.

The Radio Corporation of America began the operation of a high-powered broadcasting station at Bound Brook, N. J., for transmission of programs to Europe. This station is equipped so as to use as high as 50 kilowatts.

One of the large electrical companies conducted experiments to determine the characteristics and peculiarities inherent in the piezo crystals. Several stations are now using this quartz crystal to maintain a constant frequency which eliminates to a great extent the "beat notes" resulting from two stations heterodyning at an audio frequency. The radio-inspection service of this department has been supplied with these crystals to insure accuracy in frequency or wave-length measurements.

AMATEURS ALLOWED TO USE RADIOTELEPHONE EQUIPMENT

Effective December 7, 1925, the existing amateur regulations were amended to include authority for the use of radiotelephone equipment within the wave-length band between 3,500 and 3,600 kilocycles (85.66 and 83.28 meters), in addition to the use of the band for this service between 170 and 180 meters, at present authorized.

RADIOCOMPASS INSTALLATIONS

The following-named vessels have been equipped with a radiocompass (direction finder): *Andrea F. Luckenbach, E. T. Bedford, Franklin K. Lane, Henry D. Whiton, Henry G. Dalton, Illinois* (KDSZ), *J. A. Moffett, Manchuria, Crocus* (lighthouse tender), *Seminole*, and *Seneca* (Coast Guard cutters). The *Henry D. Whiton* and the *Crocus* are not equipped with transmitting apparatus. The *Belvidere*, which was reported in the annual list of "Commercial and Government Radio Stations of the United States," edition June 30, 1925, as being equipped with a radiocompass, is not equipped. The abbreviation "RC" after the name of the vessel should be stricken out.

RADIO FOG SIGNAL ESTABLISHED ON "ELBE NO. 1" LIGHT VESSEL, ELBE RIVER (NORTH SEA), GERMANY

A radio fog signal (experimental) for the determination of a ship's bearing and distance is automatically transmitted in conjunction with the submarine sound signals during fog and misty weather. The procedure regarding this signal is as follows:

. — . . . — . .	Silent
6.6 sec.	1.253 sec.

16 dashes (— — — etc.), each of 1 second duration, with intervals of 0.253 second between each dash, total, 19.795 seconds; silent, 2.352 seconds.

This transmission takes 30 seconds and is repeated seven times in 3½ minutes and followed by a silent interval of 4 minutes. Total period, 7½ minutes. The group of seven signals is repeated six times between the fifteenth and sixtieth minute of each hour.

The submarine sound transmitter sends the Morse letter L (. — . .) once every 30 seconds, as follows:

. — . .	Silent
9 sec.	21 sec.

This signal is sent regularly, and when used in conjunction with the radio fog signal enables a ship to determine both bearing and distance from the light vessel.

Determination of bearing.—When using the radio fog signal, this operation is effected in the usual manner by the ship's direction finder; and when using the submarine sound signals, by means of the submarine sound receivers.

Determination of distance.—The submarine sound transmitter begins its signal (. — . .) after the last dot of the radio fog signal (. — . . . — . .). The number of the dash (— — — etc.) which coincides with the first dot (.) of the submarine sound signal received on board gives the distance of the ship from the light vessel in miles.

Alternatively, the number of seconds which elapse after the last dot of the radio fog signal (. — . . . — — . .), multiplied by 0.8, gives a similar result. Until further notice both signals will also be operated daily at 0700–0800, 1300–1400, and 1800–1900, G. M. T. The light vessel is located in approximately latitude

CHANGES IN RADIO FOG SIGNALS

The characteristic of the Cape Henry fog signal has been changed to groups of 2 dots and 1 dash for 1 minute, silent 2 minutes, thus:

$$\frac{\text{••— ••— etc.}}{\text{60 sec.}} \quad \frac{\text{Silent}}{\text{120 sec.}}$$

The characteristic of the Galveston Jetty fog signal has been changed to one dash repeated for 60 seconds, silent 90 seconds, thus:

$$\frac{\text{— — — — — — — — — etc.}}{\text{60 sec.}} \quad \frac{\text{Silent}}{\text{90 sec.}}$$

CHANGE IN WAVE LENGTH FOR WEATHER BULLETINS TRANSMITTED BY NEW ORLEANS (NAT)

The weather bulletins from the naval station at New Orleans, La. (NAT), at 10 and 11 a. m., seventy-fifth meridian time, are now being transmitted on a wave of 2,520 meters (119 kilocycles), instead of 2,607 meters (115 kilocycles).

ILE DE SEIN (FRANCE) LIGHT STATION FOG SIGNAL CHANGED

The radio fog signal at this station has been changed, and the characteristic of the station is as follows: The letter "S" transmitted for 15 seconds, long dashes transmitted for 30 seconds, the letter "S" transmitted for 15 seconds, silent 30 seconds, total 90 seconds. This group is given four times in succession, the total period of emission being 5 minutes and 30 seconds. The signal is made once on a 1,000-meter wave during every quarter of the hour. Approximately position is 48° 03′ N., 4° 52′ W.—*From Avis aux Navigateurs 44 (9450), Paris, November 5, 1925.*

LIZARD (ENGLAND) COMPASS STATION BEARINGS UNRELIABLE

Bearings transmitted by Lizard radiocompass station in the sector 262 to 270° are to be considered unreliable. Approximate position, 45° 59′ N., 5° 12′ W.—*From Notice to Mariners 46 (1804), Admiralty, London, 1925.*

MONSANTO (PORTUGAL) RADIO STATION TRANSMITS TIME SIGNALS

A time signal is transmitted daily from this station at 9.30 G. M. T., corresponding to 9.30 standard time. The time signal is sent out by the Lisbon Observatory (38° 42′ 30.5″ N., 9° 11′ 10.2″ W.) and is reported to be quite reliable for checking chronometers. Procedure:

Time (G. T. M.) h.	m.	s.	h	m.	s.	
9	28	00 to 9	28	32	— — . . . —	CQ time signal from Observatory of Lisbon (in Portuguese). (MST) repeated 12 times, followed by a silent period of 1 minute.
9	29	32 to 9	29	38	— — — — — —	
9	29	39 to 9	29	43	••• ••• •••	
9	29	44 to 9	29	55	— — — — — — — — —	
9	30	00			.	(time signal).

Position, 38° 43′ 47″ N., 9° 11′ 17″ W., call signal CTV, wave length, 600 meters, spark.—*From Notice to Mariners, London, November, 1925.*

COLOMBO (CEYLON) RADIO STATION TIME SIGNALS

Radio time signals are now transmitted by this station as follows: (*a*) From 5.57 to 6, G. M. T. (civil), on the wave length of 2,300 meters, c. w.; (*b*) from 16.57 to 17, G. M. T. (civil), on the wave length of 600 meters, spark. Indian standard time is 5 hours and 30 minutes in advance of the above-mentioned times. The time signals heretofore transmitted from 4.57 to 5 and 17.57 to 18 G. M. T. (civil), have been discontinued. Location (approximately) 6° 55′ N.,

CHOSHI AND TOKIO (JAPAN) RADIO STATION TIME SIGNALS

The radio station at Choshi (Hon Choshi Machi) and Tokio (Funabashi) now transmit radio time signals twice daily, commencing at 2 and 12, G. M. T., corresponding to 11 and 21 Japanese standard time, respectively, except on Sundays and holidays, when only one transmission is made. The signals are automatically controlled by Tokio Observatory, and the procedure is given below.

Choshi radio station: The form of transmission of the time signals is as follows:

Time (G. M. T.) h.	m.	s.		h.	m.	s.	Signal
1 / 11	59	00	to	1 / 11	59	55	— — — — — — — — — — etc. (warning).
2 / 12	00	00	to	2 / 12	00	01	— — (first time signal).
2 / 12	00	30	to	2 / 12	00	55	— — . — — . — — . — — . etc. (warning).
2 / 12	01	00	to	2 / 12	01	01	— — (second time signal).
2 / 12	01	30	to	2 / 12	01	55	— — . . — — . . — — . . etc. (warning).
2 / 12	02	00	to	2 / 12	02	01	— — (third time signal).
2 / 12	02	30	to	2 / 12	02	55	— — . . . — — . . . — — . . . etc. (warning).
2 / 12	03	00	to	2 / 12	03	01	— — (fourth time signal).
2 / 12	03	30	to	2 / 12	03	55	— — . . . . — — . . . . — — . . . . etc. (warning).
2 / 12	0	00	to	2 / 12	04	01	— — (fifth time signal).

The beginning of the dash is the time signal. On Sundays and holidays the time signals between 12 and 12.04, G. M. T., only are sent. Position (approximately) 35° 44′ N., 140° 51′ E.; call signal, JCS; wave length, 600 meters, spark.

Tokio radio station: The form of transmission and the times the signal are sent is identical with that used for Choshi radio time signals. Position (approximately) 35° 43′ N., 139° 58′ E.; call signal, JJC; wave length, for the time signal commencing at 2 G. M. T. the wave length is 7,700 meters, c. w., and at 12 it is 4,400 meters, spark.—*From Notice to Mariners, London, November, 1925.*

BROADCASTING STATIONS EQUIPPED SO AS TO SUPPRESS HARMONICS

Hereunder is given a list of broadcasting stations reported by supervisors of radio of this office as being equipped so as to suppress harmonics. This list is additional to the list published in the Radio Service Bulletin for December, 1925.

Call signal	Location	Owner
KFAB	Lincoln, Nebr.	Nebraska Buick Auto Co.
KFDZ	Minneapolis, Minn.	Harry O. Iverson.
KFEL	Denver, Colo.	W. L. Wisner Radio Shop.
KFH	Wichita, Kans.	Hotel Lassen (Rigby-Gray Hotel Co.).
KFI	Los Angeles, Calif.	Earl C. Anthony (Inc.).
KFKU	Lawrence, Kans.	University of Kansas
KFKX	Hastings, Nebr.	Westinghouse Electric & Manufacturing Co.
KFMX	Northfield, Minn.	Carleton College.
KFNF	Shenandoah, Iowa.	Henry Field Seed Co.
KFOA	Seattle, Wash.	Rhodes Department Store.
KFON	Long Beach, Calif.	Echophone Radio Shop.
KFQA	St. Louis, Mo.	The Principia.
KFRU	Columbia, Mo.	Stephens College.
KFSG	Los Angeles, Calif.	Echo Park Evangelistic Association.
KFUO	St. Louis, Mo.	Concordia Seminary.
KFWB	Hollywood, Calif.	Warner Bros. Pictures (Inc.).

Call signal	Location	Owner
KLX	Oakland, Calif.	Tribune Publishing Co.
KLZ	Denver, Colo.	Reynolds Radio Co.
KMA	Shenandoah, Iowa	May Seed & Nursery Co.
KMTR	Los Angeles, Calif.	K. M. Turney Radio Corporation.
KNX	Do.	Los Angeles Evening Express.
KOA	Denver, Colo.	General Electric Co.
KOIL	Council Bluffs, Iowa	Monarch Manufacturing Co.
KPO	San Francisco, Calif.	Hale Bros.
KPSN	Pasadena, Calif.	Pasadena Star-News.
KSAC	Manhattan, Kans.	Kansas State Agricultural College.
KSD	St. Louis, Mo.	Post-Dispatch (Pulitzer Publishing Co.).
KSO	Clarinda, Iowa	A. A. Berry Seed Co.
KTAB	Oakland, Calif.	Tenth Avenue Baptist Church.
KWCR	Cedar Rapids, Iowa	Harry F. Pear.
KYW	Chicago, Ill.	Westinghouse Electric & Manufacturing Co.
WAAF	Do.	Chicago Daily Drovers Journal.
WAMD	Minneapolis, Minn.	Hubbard & Co.
WBBM	Chicago, Ill.	Atlas Investment Co.
WBCN	Do.	Foster & McDonnell.
WCAJ	University Place, Nebr.	Nebraska Wesleyan University.
WCAL	Northfield, Minn.	St. Olaf College.
WCBD	Zion, Ill.	Wilbur G. Voliva.
WCCO	Minneapolis-St. Paul, Minn.	Washburn-Crosby Co.
WCEE	Elgin, Ill. (near)	Liberty Weekly.
WCSH	Portland, Me.	Congress Square Hotel Co.
WDAF	Kansas City, Mo.	Kansas City Star.
WDWF	Cranston, R. I.	Dutee W. Flint.
WEBH	Chicago, Ill.	Edgewater Beach Hotel Co.
WERI	Boston, Mass.	Edison Electric Illuminating Co.
WENR	Chicago, Ill.	All American Radio Corporation.
WFKB	Do.	Francis K. Bridgman.
WGES	Oak Park, Ill.	Oak Leaves Broadcasting Station (Coyne Electrical School).
WGN	Chicago, Ill.	Chicago Tribune (Drake Hotel-Whitestone Co.).
WHA	Madison, Wis.	University of Wisconsin.
WHAD	Milwaukee, Wis.	Marquette University and Milwaukee Journal.
WHAS	Louisville, Ky.	Courier-Journal and Louisville Times.
WHB	Kansas City, Mo.	Sweeney School Co.
WHDI	Minneapolis, Minn.	William Hood Dunwoody Industrial Institute.
WHO	Des Moines, Iowa	Bankers Life Co.
WHT	Deerfield, Ill.	Radiophone Broadcasting Corporation.
WIBO	Chicago, Ill.	Nelson Bros. (Russo & Florito Orchestral Exchange).
WJAR	Providence, R. I.	The Outlet Co.
WJAZ	Mount Prospect, Ill.	Zenith Radio Corporation.
WJBL	Decatur, Ill.	William Gushard Dry Goods Co.
WJJD	Mooseheart, Ill.	Supreme Lodge, Loyal Order of Moose.
WKAF	Milwaukee, Wis.	WKAF Broadcasting Co.
WLB	Minneapolis, Minn.	University of Minnesota.
WLIB	Elgin, Ill. (near)	Liberty Weekly.
WLS	Crete, Ill.	Sears, Roebuck & Co.
WLSI	Cranston, R. I.	Lincoln Studios.
WLTS	Chicago, Ill.	Lane Technical High School.
WMAF	Dartmouth, Mass.	Round Hills Radio Corporation.
WMAQ	Chicago, Ill.	Chicago Daily News Co.
WMBB	Do.	American Bond & Mortgage Co.
WNAC	Boston, Mass.	Shepard Stores.
WOAW	Omaha, Nebr.	Woodmen of the World.
WOC	Davenport, Ill.	Palmer School of Chiropractic.
WOI	Ames, Iowa	Iowa State College.
WOK	Homewood, Ill.	Neutrowound Radio Manufacturing Co.
WOQ	Kansas City, Mo.	Unity School of Christianity.
WORD	Batavia, Ill.	Peoples Pulpit Association.
WOS	Jefferson City, Mo.	Missouri State Marketing Bureau.
WQJ	Chicago, Ill.	Calumet Rainbo Broadcasting Co.
WSBC	Do.	World Battery Co.
WSOE	Milwaukee, Wis.	School of Engineering of Milwaukee.
WSUI	Iowa City, Iowa	State University of Iowa.
WTAG	Worcester, Mass.	Worcester Telegraph Publishing Co.
WTIC	Hartford, Conn.	Travelers Insurance Co.
WWAR	Plainfield, Ill.	Electric Park (Lawrence J. Crowley).

A STATISTICAL STUDY OF CONDITIONS AFFECTING THE DISTANCE RANGE OF RADIOTELEPHONE BROADCASTING STATIONS

The conditions affecting radio transmission are well known to be too complex to permit a simple analysis. A direct method of studying such conditions and their variations is the analysis of a large number of similar observations taken by an organized group of observers of receiving conditions. The Bureau of Standards has made such an investigation, and part of the results are described in a paper just issued, Technologic Paper No. 297, A Statistical Study of Conditions Affecting the Distance Range of Radiotelephone Broadcasting Stations, by C. M. Jansky, jr. This paper describes one year of the investigation of conditions affecting distance range of broadcasting stations by the Bureau of Standards with the aid of about 100 voluntary observers. The observations were made for a year in the period 1922 and 1923 on transmitting station KDKA of the Westinghouse Electric & Manufacturing Co., located at East Pittsburgh, Pa. The observers were scattered over all distances up to 400 miles from the transmitting station. The data obtained were analyzed on automatic machines. The paper gives charts showing (1) variation of strength of atmospherics, (2) variation of fading, (3) relative magnitude of obstacles to reception, (4) variation of interference from receiving sets, (5) relative magnitude of obstacles to reception grouped in bimonthly periods, and (6) mean reliability of reception as a function of distance. A copy of this paper may be obtained for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

RADIO-FREQUENCY RESISTANCE AND INDUCTANCE OF COILS USED IN BROADCAST RECEPTION

The results of a series of tests by the Bureau of Standards on coils of different shapes and wound with different kinds of wire are given in a paper just issued. This gives the experimental data on the radio-frequency resistance and inductance of these coils within the range of broadcast frequencies. The results of the tests are plotted in graphs, so that the reader can use them for selecting a coil for a desired purpose. The dimensions used are for coils suitable for broadcast receiving apparatus. A discussion of the important characteristics of coils is given.

This paper is Bureau of Standards Technologic Paper No. 298, Radio Frequency Resistance and Inductance of Coils Used in Broadcast Reception, by A. Hund and H. B. De Groot, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

STANDARD FREQUENCY STATIONS

As a result of measurements by the Bureau of Standards upon the transmitted waves of a limited number of radio transmitting stations, data are given in each month's Radio Service Bulletin on such of these stations as have been found to maintain a sufficiently constant frequency to be useful as frequency standards. There may be many other stations maintaining their frequency just as constant as these, but these are the only ones among those observed. There is, of course, no actual guaranty that the stations named below will maintain the constancy shown, but the data indicate the high degree of confidence that can be placed in them. The transmitted frequencies from these stations can be utilized for standardizing frequency meters and other apparatus by the procedure given in Bureau of Standards Letter Circular No. 171, which may be obtained by a person having actual use for it upon application to the Bureau of Standards,

Station	Owner	Location	Assigned frequency (kilocycles)	Period covered by measurements (months)	Number of times measured	Deviations from assigned frequencies noted in measurements	
						Average	Greatest since Nov. 20, 1925
						Per cent	*Per cent*
WQL	Radio Corporation of America.	Coram Hill, L. I., N. Y.	17.13	12	79	0.2	0.1
NSS	United States Navy	Annapolis, Md.	17.50	28	207	.2	.1
WCI	Radio Corporation of America.	Barnegat, N. J.	17.95	10	57	.2	.2
WGG	Do.	Tuckerton, No. 1, N. J.	18.86	26	217	.2	.2
WII	Do.	New Brunswick, N. J.	21.80	8	69	.1	.2
WRT	Do.	do.	22.60	7	24	.1	.1
WVA	United States Army	Annapolis, Md.	100	9	101	.2	.4
NAA	Do.	Arlington, Va.	[1] 113	2	18	.1	.3
WJR	Jewett Radio & Phonograph Co.	Pontiac, Mich.	[2] 580	3	15	0	0
WCX	Detroit Free Press						
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	610	12	87	0	0
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	640	27	120	.1	.2
WRC	Radio Corporation of America.	do.	640	24	107	.1	.2
WSB	Atlanta Journal	Atlanta, Ga.	700	27	139	.2	.3
WGY	General Electric Co.	Schenectady, N. Y.	790	20	151	.1	.0
WBZ	Westinghouse Electric & Manufacturing Co.	Springfield, Mass.	900	20	46	.1	.2
KDKA	Do.	East Pittsburgh, Pa.	970	27	193	.1	.4

[1] Time signal frequency.
[2] Same transmitting set for both call letters (WJR and WCX).

STANDARD RADIO-FREQUENCY TRANSMISSIONS, JANUARY TO MARCH

The Bureau of Standards transmits, twice a month, radio signals of definitely announced frequencies for use by the public in standardizing frequency meters (wave meters) and transmitting and receiving apparatus. The signals are transmitted from the bureau station WWV, Washington, D. C., and from station 6XBM, Stanford University, Calif.

The transmissions are by unmodulated continuous-wave radiotelegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of the 8-minute period and continues for about 2 minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters (WWV or 6XBM) intervening. This signal continues for about 4 minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted and contain a statement of the frequency. An announcement of the next frequency to be transmitted is then given. There is then a 4-minute interval while the transmitting set is adjusted for the next frequency.

The signals can be heard and utilized by stations equipped for continuous-wave reception at distances within about 500 to 1,000 miles from the transmitting stations. Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 171, which may be obtained on application from the Bureau of Standards, Washington, D. C. Even though only a few points are received, persons can obtain as complete a wave-meter calibration as desired by the method of generator harmonics, information on which is given in the letter circular.

There was an exception, on December 5, to the regularity with which these

The schedule of future transmissions of standard frequency signals through March from both the Bureau of Standards and Stanford University is as follows:

Schedule of frequencies in kilocycles

[Approximate wave lengths in meters in parenthesis]

Time [1]	Jan. 5	Jan. 20	Feb. 5	Feb. 20	Mar. 5	Mar. 20
10 to 10.08 p. m.	1, 500 (200)	3, 000 (100)	125 (2, 400)	300 (1, 000)	550 (545)	1, 500 (200)
10.12 to 10.20 p. m.	1, 650 (182)	3, 300 (91)	133 (2, 254)	315 (952)	630 (476)	1, 650 (182)
10.24 to 10.32 p. m.	1, 800 (167)	3, 600 (83)	143 (2, 097)	345 (869)	730 (411)	1, 800 (167)
10.36 to 10.44 p. m.	2, 000 (150)	4, 000 (75)	155 (1, 934)	375 (800)	850 (353)	2, 000 (150)
10.48 to 10.56 p. m.	2, 200 (136)	4, 400 (68)	166. 5 (1, 800)	425 (705)	980 (306)	2, 200 (136)
11 to 11.08 p. m.	2, 450 (122)	4, 900 (61)	205 (1, 463)	500 (600)	1, 130 (265)	2, 450 (122)
11.12 to 11.20 p. m.	2, 700 (111)	5, 400 (55)	260 (1, 152)	600 (500)	1, 300 (231)	2, 700 (111)
11.24 to 11.32 p. m.	3, 000 (100)	6, 000 (50)	315 (952)	666 (450)	1, 500 (200)	3, 000 (100)

[1] Eastern standard time for WWV, Washington, D. C.; Pacific standard time for 6XBM, California.

REFERENCES TO CURRENT RADIO LITERATURE

This is a monthly list of references prepared by the radio laboratory of the Bureau of Standards and is intended to cover the more important papers of interest to professional radio engineers which have recently appeared in periodicals, books, etc. The number at the left of each reference classifies the reference by subject, in accordance with the scheme presented in A Decimal Classification of Radio Subjects—An Extension of the Dewey System, Bureau of Standards Circular No. 138, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. The various articles listed below are not obtainable from the Bureau of Standards. The various periodicals can be consulted at large public libraries.

R100.—*Radio principles*

R110 Riley, J. What are radio waves. Radio News, 7, pp. 966-967, January, 1926.

R113 Dunlap, O. E. Does a radio roof top the world? Scientific American, 133, pp. 378-379, December, 1925.

R113.1 Pickard, G. W. The nature, cause, and reduction of fading. Modern Wireless (London), 5, pp. 349-354, December, 1925.

R113.1 King, R. W. Observations on fading and distortion point to new explanation of the phenomena. New York Herald-Tribune, Radio Section, p. 2, November 22, 1925.

R113.5 Davis, C. L. New facts about the aurora borealis. Radio News, 7, p. 964, January, 1926.

R115 Friis, H. T. A new directional receiving system. Proc. Inst. of Radio Engrs., 13, pp. 685-707, December, 1925.

R125.1 Reyner, J. H. The direction finding equipment at Niton and Culleercoats. Jour. Inst. of Elec. Engrs. (London), 63, pp. 1138-1140, November, 1925.

R125.1 Ellis, W. G. Radio receiving system. United States Patent No. 1562877, issued November 24, 1925.

R125.6 Haising, R. A. Directive radio transmission system. United States Patent No. 1562961, issued November 24, 1925.

R134 Colebrook, F. M. The rectification of small radio frequency potential differences by means of triode valves. Experimental Wireless (London), 2, pp. 865-877, November, 1925.

R134.4 London, V. D., and Jarvis, K. W. An analysis of regenerative amplification. Proc. Inst. Radio Engrs., 13, pp. 709-753, December, 1925.

R134.75 Nicols, H. W. Wave receiving system. United States Patent No. 1563644, issued December 1, 1925.

R200.—*Radio measurements and standardization*

R210 Baker, J. A. Receiver and wave-meter calibration. QST, 8, pp. 15-19, December, 1925.

R214 Hartley, R. V. L. Translating device. United States Patent No. 1565566, issued December 15, 1925.

R300.—*Radio apparatus and equipment*

R330 Mathison, V. G. How much should a radio tube cost. Radio (San Francisco), 7, pp. 10-12, December, 1925.

R331 Housekeeper, W. G. Electric discharge device. United States Patent No. 1565151, issued December 8, 1925.

R331 Housekeeper, W. G. Vacuum insulator and its assembly. United States Patent No. 1565153,

R331 Griffith, T. R. Electron discharge device. United States Patent No. 1565562, issued December 15, 1925.
R331 Housekeeper, W. G. Electron discharge device. United States Patent No. 1565569, issued December 15, 1925.
R331 Housekeeper, W. G. Electron discharge device. United States Patent No. 1565570, issued December 15, 1925.
R331 Stoekle, E. R. Electron discharge device. United States Patent No. 1565600, issued December 15, 1925.
R331 Trimble, R. F. Electron discharge device. United States Patent No. 1565603, issued December 15, 1925.
R331 Bullimore, W. R. Thermionic valve. United States Patent No. 1565708, issued December 15, 1925.
R331 Kelly M. J. Vacuum tube manufacture. United States Patent No. 1565857, issued December 15, 1925.
R333 Lilienfeld, J. E. High vacuum device for influencing currents. United States Patent No. 1565659, issued December 15, 1925.
R333 Huppert, H. K. Radio vacuum tube. United States Patent No. 1564070, issued December 1, 1925.
R333 Hull, A. W. Electron discharge apparatus. United States Patent No. 1564352, issued December 8, 1925.
R341 St. James, R. T. Detector for wireless systems. United States Patent No. 1564641, issued December 8, 1925.
R341 Hull W. W. Dynatron synchronous detector. United States Patent No. 1564851, issued December 8, 1925.
R342 Kellogg, E. W. Construction d'amplificateurs de puissance sans distortion. L'Onde Electrique, 4, pp. 474-491. November, 1925.
R342.15 Nyquist, H. Electrical transformer. United States Patent No. 1564266, issued December 8, 1925.
R343.7 Barnsley, J. Methods of battery elimination. Radio News, 7, pp. 978-979, January, 1926.
R343.7 Best, G.M. The ABC battery eliminator. Radio (San Francisco), 7, pp. 15-17, December, 1925.
R344 Johnson, J. B. Circuit arrangement for discharge device. United States Patent No. 1565157, issued December 8, 1925.
R344 Gorton, W. S. Oscillation generator. United States Patent No. 1563263, issued December 1, 1925.
R344 Chubb, L. W. Electron tube oscillator. United States Patent No. 1565416, issued December 15, 1925.
R344 Crandall, I. B. Electrical circuits for the production of musical tones. United States Patent No. 1564309, issued December 8, 1925.
R344 Round, H. J. Wireless telegraph and telephone transmission. United States Patent No. 1564627, issued December 8, 1925.
R344.3 Ennis, E. Motorized short wave phone transmission (on 65 meters). Radio (San Francisco), 7, p. 19, December, 1925.
R344.3 Little, D. G. Radiotransmitter. United States Patent No. 1565478, issued December 15, 1925.
R344.3 Ryan, P. M. Radiotransmitter. United States Patent No. 1565506, issued December 15, 1925.
R344.3 Little, D. G. Vacuum tube stabilizing means. United States Patent No. 1565477, issued December 15, 1925.
R344.3 Winters and Byrnes. Quartz crystals control wave lengths of broadcast stations. Radio News, 7, pp. 952-953, January, 1926.
R344.5 Conrad, F. Signaling system. United States Patent No. 1563342, issued December 1, 1925.
R345 David, P. Note sur un nouveau procede de modulation des emmeteurs a lampes. L'Onde Electrique, 4, pp. 470-473, November, 1925.
R348 Arnold, H. D. Two-way repeater circuits. United States Patent No. 1565302, issued December 15, 1925.
R351 Harrison, H. C. Attachment for oscillation generators. United States Patent No. 1565092, issued December 8, 1925.
R351 Horton, J. W. Oscillation generator. United States Patent No. 1565150, issued December 8, 1925.
R357 Greenwood, T. T. Frequency doubling in vacuum tubes. QST, 9, pp. 29-30, December, 1925.
R370 Clausen, H. P. Signaling system. United States Patent No. 1565625, issued December 15, 1925.
R374 Hartmann, M. L. and Meagher, J. R. The new carborundum detector. QST, 9, pp. 31-32, December, 1925.
R374 Sargent, E. M. An ultra selective crystal set. Radio (San Francisco), 7, pp. 13-14, December, 1925.
R375 Snelling, W. O. Current rectifying device. United States Patent No. 1565595, issued December 15, 1925.
R375 Coblentz, W. W. Optical means for rectifying alternating currents. United States Patent No. 1563557, issued December 1, 1925.
R376.8 Maliet, E. Simple acoustic measurements on loud speakers and telephones. Wireless World and Radio Review, 17, pp. 667-671, November 11, 1925.
R381 Gernsback, H. Variable condenser. United States Patent No. 1562629, issued November 24, 1925.
R381 Trees, H. Variable condenser. United States Patent No. 1562812, issued November 24, 1925.
R381 Wolison, H. M. Variable condenser. United States Patent No. 1563416, issued December 1, 1925.
R381 Russell, A. Variable condenser. United States Patent No. 1563440, issued December 1, 1925.
R381 Jacobson, P. G. Electrostatic condenser. United States Patent No. 1563709, issued December 1, 1925.
R381 Latour, M. Electrical condenser. United States Patent No. 1563754, issued December 1, 1925.
R381 Lindberg, J. F. Condenser. United States No. 1563758, issued December 1, 1925.
R381 Cohen, S. Multiple variable condenser. United States Patent No. 1563893, issued December 1, 1925.
R381 Henschel, C. J. Combined shield plate, dial and vernier. United States Patent No. 1564672, issued December 8, 1925.
R381 Gargan, J. O. Condenser. United States Patent No. 1565068, issued December 8, 1925.
R381 Dodson, H. S., and Shirey, W. H. Condenser. United States Patent No. 1563351, issued

R382 Brown, W. W., and Love, J. E. Designs and efficiencies of large air core inductances. Proc. Inst. Radio Engrs., 13, pp. 755–770, December, 1925.
R382 Clemons, D. R. Some new and useful facts about coils. Popular Radio, 8, pp. 30–39, January, 1926.
R382 Which type of coil is best? Radio News, 7, pp. 988–987, January, 1926.
R382 Marco, F. J. Toroids. QST, 9, pp. 9–12, December, 1925.
R385.1 Alexanderson, E. F. W. Radio signaling system. United States Patent No. 1564807, issued December 8, 1925.
R386 Dellenbaugh, F. S. Amateur filter problems. QST, 9, pp. 24–26, December, 1925.
R387.1 Smith-Rose, R. L. How to obtain effective screening. Wireless World and Radio Review, 17, pp. 694–699, November 18, 1925.
R387.1 Lerchen, E. H. Shield for amplifier or detector tubes. United States Patent No. 1564694, issued December 8, 1925.
R388 Wold, P. I. System for location of a source of wave energy. United States Patent No. 1564303, issued December 8, 1925.
R388 MacGregor-Morris, J. T., and Mines, R. Measurements in electrical engineering by means of cathode rays (complete bibliography at end). Jour. Inst. of Elec. Engrs. (London), 63, pp. 1086–1107, November, 1925.
R388 Wood, A. B. The cathode-ray oscillograph. Jour. Inst. of Elec. Engrs. (London), 63, pp. 1046–1055, November, 1925.
R388 Fleming, J. A. The cathode-ray tube as a wattmeter and phase measurer for high-frequency currents. Jour. Inst. of Elec. Engrs. (London), 63, pp. 1045–1046, November, 1925.
R388 Bazzoni, C. B. The cathode-ray oscillograph in radio work. Radio News, 7, pp. 987–988, January, 1926.
R388 van der Bijl, H. J. Vacuum tube and method of operating the same. United States Patent No. 1563873, issued December 15, 1925.

R400.—*Radio communication systems*

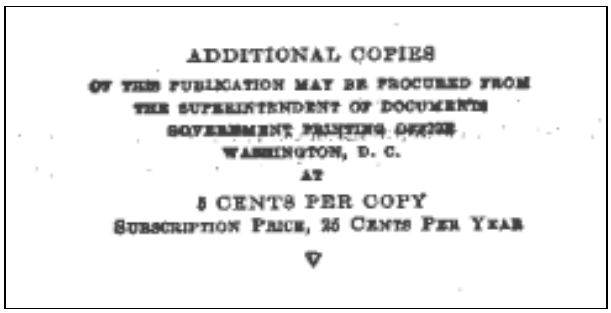
R402 Taylor, A. H. An investigation of transmission on the higher radio frequencies. Proc. Inst. Radio Engrs., 13, pp. 677–688, December, 1925.
R402 Hagemann, N. A universal short-wave transmitter. Radio Broadcast, 8, pp. 321–325, January, 1926.
R413 Marbury, R. E. Wireless receiving system. United States Patent No. 1563425, issued December 1, 1925.
R413 Horton, J. W. Carrier-wave signaling system. United States Patent No. 1566012, issued December 15, 1925.
R413 Coram, R. E. Circuits for the production of pure modulated carrier waves. United States Patent No. 1563947, issued December 15, 1925.
R422 Fuller, L. F., and Sweet, G. C. Arc converter. United States Patent No. 1562952, issued November 24, 1925.
R422 Eaton, W. A. Method of and apparatus for controlling a. c. United States Patent No. 1565318, issued December 15, 1925.
R435 Stone, J. S. Secret communication system. United States Patent No. 1565521, issued December 15, 1925.
R470 Bown, R. Radio transmission system. United States Patent No. 1565544, issued December 15, 1925.
R470 Green, C. W. Transmission regulation. United States Patent No. 1566925, issued December 15, 1925.

R500.—*Applications of radio*

R510 Affel, H. A. Movement and position indicator. United States Patent No. 1562483, issued November 24, 1925.
R515 Dinsdale, A. Combined wireless and submarine signaling in ship navigation. Radio News of Canada, 4, pp. 17–19, November, 1925.
R533 Lescarbotura, A. C. Radio for train signals. Radio (San Francisco), 7, p. 18, December, 1925.
R536 Ingalls, A. G. Buried treasure (apparatus for locating underground minerals, etc.). Scientific American, 133, pp. 392–393, December, 1925.
R536 Chapman, F. S. Method of detecting the presence and approximate location of metallic masses. United States Patent No. 1564940, issued December 8, 1925.
R550 Booklet of American and Canadian broadcasters (list of stations and call letters). Radio Broadcast, 8, pp. 337–340, January, 1926.
R550 Clark, A. B. Arrangement for controlling volume range. United States Patent No. 1565548, issued December 15, 1925.
R550 Clemant, E. E. Radiophone system. United States Patent No. 16291, reissued December 15, 1925.
R561 Snook, H. C. Signal system. United States Patent No. 1565396, issued December 15, 1925.
R570 Jacobs, A. M. McCook Field radio car (controlled by radio). Radio News, 7, p. 971, January, 1926.
R570 Brady, J. B. Radio receiving system. United States Patent No. 1562820, issued November 24, 1925.
R570 Brady, J. B. Radio receiving system. United States Patent No. 1563958, issued December 1, 1925.
R580 Turpain, A. Optique et electricite. L'Onde Electrique, 4, pp. 453–461, November, 1925.
R582 Dewhirst, T. F. Practical picture transmission. QST, 9, pp. 13–17, December, 1925.

R300.—*Non-radio subjects*

347.7 De Forest, L. Advice to inventors (patents). Radio News, 7, pp. 946–947, January, 1926.
534 Fessenden, R. A. Signaling by ultra-audible sound waves. United States Patent No. 1562930, issued November 24, 1925.
621.327.4 Thomas, P. Mercury vapor spark gap. United States Patent No. 1565520, issued December 15, 1925.
621.327.7 Thomson, E. Regulator for inclosed electrical apparatus. United States Patent No. 1562061, issued November 24, 1925.


ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY
SUBSCRIPTION PRICE, 25 CENTS PER YEAR

Return to Radio Service Bulletins Index