DEPARTMENT OF COMMERCE

RADIO SERVICE BULLETIN

ISSUED MONTHLY BY BUREAU OF NAVIGATION

Washington, October 1, 1924—No. 90

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 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.
PG = General public.
PR = Limited public.
RC = Radio compass 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. W. T. Co. = Independent Wireless Telegraph Co.
K. & C. = Kilbourne & Clark Manufacturing Co.
R. C. A. = Radio Corporation of America.
S. O. R. S. = Ship Owners' Radio Service.
W. S. A. Co. = Wireless Specialty Apparatus Co.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
V. t. = Vacuum tube.
FX = Fixed station.
U. S. L. = After operating company denotes that the change applies only to the List of Radio Stations of the United States.
Kc. = Kilocycles.
Fy. = Frequency.
A. c. = Alternating current.

13355—24†——1

NEW STATIONS

Commercial land stations, alphabetically by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924, and to the International List of Radiotelegraph Stations published by the Berne Bureau]

Station	Call signal	Wave lengths	Service	Hours	Station controlled by—
Avalon, Calif.[1]	KFRD	1,613	FX	X	L. C. Dent.
Belfast, Me.[2]	WGU	1,610	FX	N	R. C. A.
Do[2]	WIR	1,750	FX	N	Do.
Chicago, Ill.[3]	WGO	800,890,706,1,800	PG	N	Do.
Tuckerton, N. J.[4]	WGH	90, 93, 97, 100, 103	FX	N	Do.
Wilmington, Calif.[5]	KFRE	1,713	FX	X	L. C. Dent.

[1] Loc., O 118° 19′ 30″, N 33° 20′ 45″; range, 25; system, Westinghouse v. t. telegraph.
[2] Loc., O 69° 00′ 00″, N 44° 24′ 50″; range, 200; system, composite v. t. telegraph.
[3] Loc., O 87° 37′ 29″, N 41° 52′ 29″; range, 200; system, R. C. A. v. t. telegraph and R. C. A., 1,000; rates, ship service, 10 cents per word.
[4] Loc. (approximately), O 74° 23′ 00″, N 39° 33′ 00″; rahge, 4,000; system, General Electric Co. v. t. telegraph; rates, Argentina, 50 cents per word; Germany, 25 cents per word; France, 22 cents per word.
[5] Loc., O 118° 16′ 15″, N 33° 46′ 10″; range, 25; system, Westinghouse v. t. telegraph.

Commercial ship stations, alphabetically by names of vessels

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924, 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—
Edward J. Berwind	KFTY		PG	X	Franklin S. S. Co	
Foam	KFUE	s	PG	X	Bay State Fishing Co	R. C. A.
Luzon	KFUH				M. R. Kellum	
Pere Marquette 22	KFUD		PG	X	Pere Marquette R. R. Co	
P. W. Sherman	KFUB		PG	X	Valley Camp S. S. Co	
Surge	KFUF	s	PG	X	Bay State Fishing Co	Do.
Thalassa	KFUG					
Wilson	KEJ				Washington Tug & Barge Co.	

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	
KEJ	Wilson	b	KFUF	Surge	b
KFRD	Avalon, Calif	c	KFUG	Thalassa	b
KFRE	Wilmington, Calif	c	KFUH	Luzon	b
KFTY	Edward J. Berwind	b	WGH	Tuckerton, N. J	c
KFUB	P. W. Sherman	b	WGO	Chicago, Ill	c
KFUD	Pere Marquette 22	b	WGU	Belfast, Me	c
KFUE	Foam	b	WIR	do	c

Broadcasting stations, alphabetically by names of cities

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924]

City	Call signal	City	Call signal
Alexandria, La	KFRF	Grafton, N. Dak	KFRH
Beeville, Tex	KFRB	Hamilton, Ohio	WEBO
Boston, Mass	WEEI	Harrisburg, Ill	WEBQ
Buffalo, N. Y	WEBR	Minneapolis, Minn	WCCO
Camden, N. J	WFBI	Richmond Hill, N. Y	WAGH
Chicago, Ill	WJAZ	St. Louis, Mo	KFRG

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

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924]

Call signal	Station operated and controlled by—	Location of station	Power (watts)	Wave length	Frequency (kilocycles)
KFRB	Beeville, Tex	Hall Brothers	250	248	1,210
KFRC	San Francisco, Calif	Radiart Studio, Whitcomb Hotel	5	280	1,070
KFRF	Alexandria, La	W. R. Brown, 222 Florence Avenue	10	242	1,240
KFRG	St. Louis, Mo	Cleveland High School	20	236	1,270
KFRH	Grafton, N. Dak	Martin L. Monson	10	268	1,120
WAHG	Richmond Hill, N. Y	A. H. Grebe & Co	500	316	950
WCCO	Minneapolis, Minn	Washburn-Crosby Co	500	417	720
WEBO	Hamilton, Ohio	Harry W. Fabrisander, 240 North Front Street.	5	250	1,200
WEBQ	Harrisburg, Ill	Tate Radio Co	10	226	1,330
WEBR	Buffalo, N. Y	H. H. Howell, 54 Niagara Street	15	240	1,250
WEEI	Boston, Mass	Edison Electric Illuminating Co. of Boston	500	303	990
WFBI	Camden, N. J	Galvin Radio Supply Co., 521 Market Street.	100	236	1,270
WFBJ	Collegeville, Minn	St. John's University	50	236	1,270
WJAZ	Chicago, Ill. (portable)	Chicago Radio Laboratory	100	268	1,120

Government land stations, alphabetically by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Station	Call signal	Wave lengths	Service	Hours	Station controlled by—
Juneau, Alaska	WUJ				U. S. Army.
Ketchikan, Alaska	WUT				Do.
Kotzebue, Alaska	WXW	1,000			Do.

Government land and ship stations, alphabetically by call signals

[b—ship station; c—land station]

Call signal	Name of station		Call signal	Name of station	
WUJ	Juneau, Alaska	c	WXW	Kotzebue, Alaska	c
WUT	Ketchikan, Alaska	c			

Special land stations, alphabetically by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1924]

Station	Call signal	Station controlled by—
Atlanta, Ga	4ZZ	Henry L. Reid, 76 East Twelfth Street.
Chicago, Ill	9ZW	W. E. Schweitzer, 4264 Hazel Avenue.
Kansas City, Mo	9ZB	Richard W. Greendycke, 3808 Wyoming Street.
Do	9ZD	Earl B. MacDowell, 3145 Karnes Boulevard.
Lansing, Mich	8XBB	Reo Motor Car Co.
Marion, Mass	1XC	Radio Corporation of America.
New York, N. Y	2XBH	City of New York, Department of Plant and Structures.
Do	2XBJ	Gimbel Bros.
Oklahoma, Okla	5YY	Central High School.
Parsons, Kans	9ZE	Clifford Himoe, 1431 Corning Street.
St. Louis, Mo	9ZF	Edmund A. Hoghin, 5658A Cote Brilliante Street.
San Rafael, Calif	6XAC	Willis E. Everette, West End.
Tuckerton, N. J	2XD	R. C. A., 66 Broad Street, New York, N. Y.

Special land stations, grouped by districts

Call signal	District and station	Call signal	District and station
	First district:	6XAC	Sixth district: San Rafael, Calif.
1XC	Marion, Mass.	8XBB	Eighth district: Lansing, Mich.
1ZAC	West Milbury, Mass.		Ninth district:
	Second district:	9ZB	Kansas City, Mo.
2XBH	New York, N. Y.	9ZD	Do.
2XBJ	Do.	9ZE	Parsons, Kans.
2XD	Tuckerton, N. J.	9ZF	St. Louis, Mo.
4ZZ	Fourth district: Atlanta, Ga.	9ZW	Chicago, Ill.
5YY	Fifth district: Oklahoma, Okla.		

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, 1924, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

ANVIK, ALASKA.—System, composite v. t. telegraph.
BOSTON, MASS. (WBF).—System, R. C. A. v. t. telegraph; w. l., 300 *600*, 690, 2,000, 2,175.
BUFFALO, N. Y.—Loc (approximately) O 78° 55′ 00″, N 42° 53′ 00″; range, 200; system, Navy-Lowenstein, 1000; w. l., 300, *600*; service, PG; hours, 9 a. m.–9 p. m.; rates, ship service, 10 cents per word.
CLEARWATER, CALIF. (KOK).—System, Federal arc and Federal, 1,000; w. l., add 706.
CLEVELAND, OHIO (WTK).—System, Navy-Simon v. t. telegraph and Navy-Lowenstein, 1,000.
DULUTH, MINN.—Range, 500; system, composite, 1000; w. l., 300, *600*, 1,800; hours, 7 a. m.–7 p. m.; rates, ship service, 10 cents per word.
HOUSTON, TEX.—Range, 200; system, Navy-Kilbourne & Clark, 1,000; w. l., 300, *600*; hours, 8–11 a. m. and 1–7 p. m.
LIMA, OHIO.—System, De Forest v. t. telegraph.
LOS ANGELES, CALIF. (KVT).—System, composite v. t. telegraph.
MIAMI, FLA.—W. l., 300, *600*, 706, 1599, 1800.
PYSHT, WASH.—Service, P (communicates only with certain land and ship stations).
ROCKY POINT, N. Y.—Range, 300; system, composite v. t. telegraph.
SAN DIEGO, CALIF. (KVU).—System, composite v. t. telegraph.
SAN FRANCISCO, CALIF. (KFS).—Range, 200–500; w. l., 300, *600*, 706, 2,400.
Strike out all particulars of the following-named stations, Cape May, N. J.; Stevens Point, Wis., Waupaca, Wis.

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, 1924, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

ADMIRAL WATSON.—System, R. C. A. v. t. telegraph and R. C. A., 1,000; w. l., 300, *600*, 706, 1,800.
AFEL.—Station operated and controlled by R. C. A. (U. S. L.).
ARTIGAS.—W. l., add 706.
BAKERSFIELD.—Station operated and controlled by R. C. A. (U. S. L.).
BAYOU CHICO.—W. l., add 706.
BROOKDALE.—Brookdale S. S. Co. owner of vessel.
CADARETTA.—Charles Nelson Co. owner of vessel.
CALORIA.—W. l., add 706.
CHESTER W. CHAPIN.—W. l., add 706; hours, X.
CITY OF FAIRBURY.—Station operated and controlled by S. O. R. S. (U. S. L.).
CLARE.—W. l., 300, *600*, 706.
COLD HARBOR.—Station operated and controlled by R. C. A. (U. S. L.).
COLLINGSWORTH.—Station operated and conrtolled by S. O. R. S. (U. S. L.).
CRANFORD.—W. l., add 706.
CRIPPLE CREEK.—Station operated and controlled by S. O. R. S. (U. S. L.).

EASTERN GLEN.—Range, 200.
ELDENA.—Station operated and controlled by R. C. A. (U. S. L.).
GENERAL O. H. ERNST.—W. l., 300, *600*, 706.
GENERAL W. C. GORGAS.—W. l., 300, *600*, 706.
GREATER DETROIT.—Range, 150; system, R. C. A. v. t. telephone and telegraph and R. C. A., 1,000; w. l., 300, *600*, 706, 1,053, 1,800; rates, Great Lakes service 4 cents per word; station operated and controlled by R. C. A.
HEREDIA.—W. l., 300, *600*, 706.
HIGHO.—Station operated and controlled by S. O. R. S. (U. S. L.).
HUMRICK.—W. l., add 706.
J. A. BOSTWICK.—Station operated and controlled by I. W. T. Co.
JOHN WORTHINGTON.—System, R. C. A., 1,000.
K. R. KINGSBURY.—W. l., add 1,800.
MUNWOOD.—W. l., 300, *600*, 706.
NEW HAMPSHIRE.—W. l., add 706.
ORTEGA.—W. l., add 706.
PANAY (KFUA).—Range, 150; system, Navy-Lowenstein, 1,000; w. l., 300, *600*, 706; rates, Great Lakes service, 4 cents per word; station operated and controlled by owner of vessel.
SAUCON.—Station operated and controlled by R. C. A.
SUJAMECO.—Rates, 8 cents per word; station operated and controlled by R. C. A.
SUSCOLANCO.—W. l., add 706.
VENTURA.—W. l., 300, *600*, 706, 2,100, 2,400.
WABAN.—Station operated and controlled by R. C. A.
WEST CARNIFAX.—Station operated and controlled by S. O. R. S.
WEST HARDAWAY.—W. l., add 706.
WEST HEMATITE.—W. l., add 706; hours, X.
WEST MUNHAM.—W. l., add 706.
WEST NIVARIA.—Station operated and controlled by I. W. T. Co. (U. S. L.).
WILHELMINA.—W. l., 300, *600*, 706.
YORBA LINDA.—W. l., add 706, 2,100, 2,400.

Strike out all particulars of the following-named vessels, Arctic, Chalmette, China, Mexicano, South American.

COMMERCIAL LAND AND SHIP STATIONS, ALPHABETICALLY BY CALL SIGNALS

Strike out all particulars following the call signals, KFHT, KGM, KKC, WCP, WCY, WEO, WPAH, WWA.

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, 1924]

KFDY (Brookings, S. Dak.).—Power, 100; w. l., 273; frequency, kc. 1,100; station operated and controlled by South Dakota State College of Agriculture and Mechanic Arts.
KFHR (Seattle, Wash.).—Power, 100; w. l., 263; frequency, kc. 1,140.
KFIZ (Fondulac, Wis.).—Station operated and controlled by Daily Commonwealth and Seifert Radio Corp.
KFKX (Hastings, Nebr.).—W. l., 291; frequency, kc. 1,030.
KFLU (San Benito, Tex.).—Power, 15; station operated and controlled by San Benito Radio Club.
KFOR (David City, Nebr.).—Station operated and controlled by David City Tire & Electric Co. (Howard A. Shuman).
KFPL (Dublin, Tex.).—W. l., 252; frequency, kc. 1,190.
KLZ (Denver, Colo.).—Power, 250.
WBAP (Fort Worth, Tex.).—Power, 1,000.
WBAX (Wilkes-Barre, Pa.).—W. l., 254; frequency, kc. 1,180.
WEAO (Columbus, Ohio).—W. l., 294; frequency, kc. 1,020.
WEAR (Baltimore, Md.).—Station operated and controlled by the Baltimore News and the American Publishing Co.
WGAZ (South Bend, Ind.).—W. l., 275; frequency, kc. 1,090.
WJAZ (Chicago, Ill.).—Call signal changed to WSAX.
WMAN (Columbus, Ohio).—Power, 50.
WRAW (Reading, Pa.).—Station operated and controlled by Avenue Radio &

Strike out all particulars of the following named stations, KFEY, Kellogg, Idaho; KFHH, Neah Bay, Wash.; KFJL, Ottumwa, Iowa; KFLD, Franklinton, La.; KFNJ, Warrensburg, Mo.; KFOL, Marengo, Iowa; KNX, Los Angeles, Calif.; WBAH, Minneapolis, Minn.; WBBM, Lincoln, Ill.; WBBN, Wilmington, N. C.; WCAZ' Carthage, Ill.; WCBF, Pittsburgh, Pa.; WCBM, Baltimore, Md.; WDBK, Cleveland, Ohio; WDBV, Fort Wayne, Ind.; WHA, Madison, Wis.; WHAH, Joplin, Mo.; WIAQ, Marion, Ind.; WIAS, Burlington, Iowa; WIL, Washington, D. C.; WLAG, Minneapolis, Minn.; WLAQ, Kalamazoo, Mich.; WLB, Minneapolis, Minn.; WMAL, Trenton, N. J.; WOAG, Belvidere, Ill.; WOAO, Mishawaka, Ind.; WOAT, Wilmington, Del.; WPAL, Columbus, Ohio; WSAB, Cape Girardeau, Mo.; WSAY, Port Chester, N. Y.; WTL, Chicago, Ill.

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, 1924, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

BAR HARBOR, ME. (R. C.).—Loc., O 68° 11′ 40″, N 44° 18′ 49″.
GLOUCESTER, MASS. Loc., O 70° 34′ 46″, N 42° 38′ 11″.
POINT ARGUELLO, CALIF.—Loc., O 120° 38′ 32″, N 34° 34′ 38″.
RELIEF LIGHT VESSEL No. 109.—Call signal changed to WWAB.
Strike out all particulars of the following-named stations, Inglewood, Calif.; Juneau, Ketchikan, Noorvik, and St. George, Alaska; San Domingo City, Dominican Republic.

GOVERNMENT LAND AND SHIP STATIONS, ALPHABETICALLY BY CALL SIGNALS

NAJC, call signal changed to WWAB; strike out all particulars following the call signals NJG, NPX, NPY, NVD, NVH, WXW (Noorvik, Alaska).

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, 1924]

ASHEVILLE, N. C. (4ZI).—Address, Fenner Avenue.
OAKLAND, CALIF. (6XW).—Station operated and controlled by H. O. de la Montanya, 2830 Eleventh Avenue.
PORT JEFFERSON, N. Y. (2XS).—*Read* Rocky Point, N. Y.
PORTLAND, OREG. (7XAD).—Station operated and controlled by Benson Polytechnic School.
SAN ANTONIO, TEX. (5XY).—Address 324 North Navarro Street.
SANTA ROSA, CALIF. (6XB).—Station operated and controlled by L. A. Drake Battery Radio Supply Shop.
WEST ALEXANDRIA, PA. (8ZQ).—Address, 92 East Dayton Street.
WILKINSBURG, PA. (8XV).—Address, 521 Pennsylvania Avenue.
Strike out all particulars of the following-named stations: Atlanta, Ga. (4XG); Battle Creek, Mich. (8XAC); Carthage, Ill. (9YAU); Cleveland, Ohio (8XBX); Cleveland, Ohio (8YAJ); Defiance, Ohio (8XM); Grove City, Pa. (8XAB); Highland Park, Mich. (8XBQ); Lexington, Ky. (near–9XBH); Lexington, Ky. (9ZI); Los Angeles, Calif. (6XBR); Mansfield, Mass. (1XAY); Morgantown, W. Va. (8XBW); Parnassus, Pa. (8XBM); Philadelphia, Pa. (3XB); Pittsburgh, Pa. (8XAQ); St. Petersburg, Fla. (4XQ); Spirit Lake, Wash. (7YR); Springfield, Ohio (8XAK).

MISCELLANEOUS

NEW RADIO FOG SIGNAL ESTABLISHED

About October 7, 1924, a radio fog signal will be established on Five Fathom Bank Light Vessel, call letters NADV. The fog signal will sound groups of 1 dash and 3 dots for 40 seconds, silent 25 seconds, thus:

– . . . – . . . – . . . – . . . &c. Silent

WEATHER REPORT TRANSMITTED BY BUFFALO STATION

Information has been received from the Hydrograph Office that the radio station of the Inter City Radio Telegraph Co., at Buffalo, N. Y., call letters WAM, will disseminate hydrographic information at 11 a. m. and 4 p. m., seventy-fifth meridian time, on 706 meters. This station will also copy and transmit all messages addressed to "Government Hydro, Buffalo." This service is free of charge, and masters of vessels navigating the Great Lakes are invited to send hydrographic information of importance to "Government Hydro, Buffalo," for dissemination by radio.

RADIO TIME SIGNAL BY SAIGON, FRENCH INDO-CHINA STATION

Radio station Saigon, French Indo-China, call letters HZA, transmits time signals on 20,800 meters at $9^h.\ 30^m.\ 00^s.$, G. M. T. (astronomical), corresponding to $16^h.\ 30^m.\ 00^s.$ standard time.

HOURS OF OPERATION OF NAVAL COMPASS STATIONS

During the first 10 minutes of each hour during clear weather radio compass stations operated by the Navy Department will ordinarily not be guarding the 800-meter wave. Vessels are requested to confine their requests for bearings during clear weather to the remaining 50 minutes of the hour as far as practicable. During the remaining 50 minutes, and at all times during inclement weather, all radio compass stations will be continuously guarding the 800-meter wave.

METEOROLOGICAL REPORTS BY SAN DIEGO NAVAL STATION

The naval radio station at San Diego, Calif., will in future broadcast the meteorological reports formerly transmitted by the Inglewood (Calif.) station. There will be no change in the time or character of emission.

CHANGE IN RATES FOR VESSELS OF NEW YORK AND CUBA MAIL S. S. CO.

Beginning September 1 last messages relayed through the ship stations named hereunder will be charged for at the rate of 8 cents per word: Esperanza, Guantanamo, Mexico, Monterey, Morro Castle, Orizaba, Siboney.

REVISED SCHEDULE OF WEATHER BULLETINS IN THE ARABIAN SEA AND THE BAY OF BENGAL

The following table will show the present hours at which signals are sent out and the wave lengths used by the different stations:

Routine period	Time of transmission G. M. T.	Time of transmission I. S. T.	Name of station	Wave length
Daily	0830	1400	Calcutta and Karachi	2,000
	1630	2200		
	0900	1430	Bombay	2,000
	1700	2230	Madras	1,000
			Rangoon	1,200
	0945	1515	Aden and Matara	2,000
	1745	2315		
Extra	0030	0600	Calcutta and Karachi	600
	0100	0630	Bombay, Madras, and Rangoon	600
	0145	0715	Aden and Matara	600
	0930	1000	Calcutta and Karachi	600
	1230	1800		
Storm	2030	0200		
	0600	1030	Bombay, Madras, and Rangoon	600
	1300	1830		
	2100	0250		

Under normal fair weather conditions bulletins will be issued only at times marked "Daily;" during stormy and unsettled weather, or when it is deemed advisable, announcements will be sent out at the times marked "Extra;" and during cyclones notifications will be sent out at the times marked "Stormy." The "Daily" notifications when sent from the Calcutta station will be preceded by time signals, and when what are called "navigational" warnings are broad-

cast they will follow the weather notifications and will be sent out on the same wave length. In all cases where it is deemed advisable special messages will be issued giving information regarding unexpected or unusual conditions or happenings. TTT "safety" signals will be given in all cases where bulletins are sent out except when the two "Daily" announcements are made.

THEORY OF DETERMINATION OF ULTRARADIO FREQUENCIES BY STANDING WAVES ON WIRES

The standardization of the frequency of radio waves has assumed a new importance with the increase of public interest in radio and the necessity of avoiding interference between radio stations operating on different frequencies. One of the methods used by the Bureau of Standards in such standardization is the accurate measurement of the length of very short waves on a system of parallel wires. A paper furnishing the theoretical background for this method of frequency standardization has just been issued. The essential differences between the parallel wire system employed in this work and somewhat similar systems in the earliest days of radio are: High-frequency voltages are impressed on the wires instead of being caused by discharges originating on the wires; the waves produced are continuous instead of being damped; an electron-tube generating set is substituted for the spark-gap circuit; a current-indicating instrument is used instead of a device for indicating voltage nodes.

Correct results can be obtained if the correction derived in the paper is employed in calculating the frequency. It is shown that the adjustment is based on a condition of resonance, and therefore the settings are sharp, and it is practical to approach the theoretical accuracy in actual frequency standardization. The paper gives practical deductions that may be drawn from the mathematical theory and also the method of calculating the frequency correction. An appendix gives the complete mathematical theory of the action of standing waves on parallel wires as applied to frequency measurement.

This paper is Bureau of Standards Scientific Paper No. 491, Theory of Determination of Ultraradio Frequencies by Standing Waves on Wires, by Dr. A. Hund, a copy of which may be obtained for 15 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

PIEZOELECTRIC CRYSTALS AS RADIO STANDARDS

Piezoelectricity is an old phenomenon which is having some remarkable new applications. Certain crystals undergo a slight expansion or contraction when an electrical voltage is applied to them, and vice versa produce a slight voltage when compressed or pulled. Such crystals (quartz and rochelle salt) were developed during the war as submarine detectors, since when placed under water they respond to the sound vibrations produced by the propeller of a submarine. Any piece of quartz crystal has certain natural frequencies of vibration, like a tuning fork, except that the frequency is very high. A piece of quartz crystal 1 or 2 inches long has a natural frequency of the same order as the frequencies of currents used in radio communication. American investigators have found that the frequency of vibration of the piece of quartz is extraordinarily constant, and that it is very useful as a radio standard.

The quartz crystal may be used as a standard in numerous ways. In one method it forms an auxiliary condenser in a resonance circuit, and when the current in the circuit is made to have a frequency equal to that of natural vibration of the crystal there is a definite power absorption from the circuit. In another method the quartz crystal, in association with a small electron tube, acts as an oscillator or generator of a current the frequency of which is that of mechanical vibration of the piece of crystal. As the frequency thus produced is accompanied by numerous harmonics, the crystal is a standard giving several radio frequencies. It is thus a supplement to the wave meters which have hitherto been used as standards of radio frequency. It appears to be a standard of greater constancy than the best wave meters.

Studies being made by the Bureau of Standards indicate that such a quartz oscillator has many valuable applications in radio work. Means of producing audio as well as radio frequencies are being worked out. The crystals can be used to control or determine the frequency of a transmitting station and to hold it strictly constant. This will mean a great advance in radio transmission technique. The crystals are also useful in accurate setting of receiving apparatus and in controlling the frequency of radio-frequency generators used in laboratory

use. No publications on this work have as yet been prepared by the bureau. When such publications become available, they will be announced in the Radio Service Bulletin.

RADIO STANDARDIZATION

During the past year there has been increasing interest and a beginning of organized effort in the standardization of radio apparatus, and progress in this direction continues. The Bureau of Standards participates in this work through representation on the various committees and boards which are engaged in the several phases of the movement.

A sectional committee on radio has been organized under the procedure of the American Engineering Standards Committee. This sectional committee deals with standardization of apparatus and nomenclature. It has 26 members, representing various producing, consuming, distributing, and general radio interests. Its technical work will be carried on by subcommittees on the following subjects: Transmitting and receiving sets and installations, component parts and wiring, electron tubes, electroacoustic devices, power supply, and outside plant.

The Interdepartment Radio Advisory Committee gives attention to standardization of radio equipment for Government use through the work of its subcommittee on technical problems. It has recently adopted a standard receiving electron tube, which is recommended for use by the Government departments. Before a company can submit bids for these tubes it must submit a sample of 50 tubes on which specified tests must be made. The Bureau of Standards, Signal Corps, and Bureau of Engineering, Navy Department, cooperate in making these tests. One company has already submitted samples. The committee is now working on the standardization of 50-watt transmitting tubes and condensers for Government use.

A Committee on Radio Apparatus has been formed by the Federal Specifications Board. This committee will adopt standard specifications for use in purchase of radio equipment by all Government departments.

The Standardization Committee of the Institute of Radio Engineers is preparing a revision of the "Definitions of terms and standard graphical symbols" (1922). This work is proceeding actively through subcommittees which handle the following branches of the subject: Radio telegraphy transmitting sets, radio telegraphy receiving sets, radio telephony, electron tubes, antennas, direction-finding apparatus and systems.

RADIO IN HOSPITALS

One of the most beneficent fields of usefulness of radio is the reception of radio broadcasting in hospitals. Besides the benefit to patients through providing entertainment, medical authorities testify to the actual therapeutic value of the mental relief thus afforded. The Bureau of Standards is assisting in the technical phases of current movements to equip many thousands of hospital beds with radio service. Since the middle of March of this year there has been a popular campaign directed from one of the large broadcasting stations which has raised funds for the installation of radio in the United States military service hospitals. A technical committee of Government experts (representing the Signal Corps, Navy Department, and Bureau of Standards) is furnishing technical advice as to the material and method of installation for these hospitals. The first hospitals equipped were Walter Reed General Army Hospital, Naval Hospital, and Mount Alto Veterans' Bureau Hospital, all located in Washington, D. C.

The general system employed is to use one receiving set and a powerful amplifier to supply the entire hospital, each patient being supplied with head telephone receivers which can be connected or disconnected at will. The amplifier used is capable of supplying about 3,000 head sets in parallel, and by reducing the number of head sets and using suitable transformers a number of loud speakers may also be used in the various rooms. At Walter Reed Hospital 1,500 head sets and six loud speakers are used, the loud speakers being provided for assembly halls only. This equipment requires the services of one man continuously while the set is in operation, to control the volume of sound delivered to the patients. The set used is capable of receiving distant as well as local programs, but because of disturbances that may be introduced in distant reception local programs are used except on special occasions where a program of very general interest is being broadcast from a distant station. The installation includes a microphone which is used for the distribution to the patients of programs given in the auditorium or elsewhere in the hospital. This microphone makes it possible for any

The work of equipping other hospitals is being continued, and the material for all service hospitals in the vicinity of New York City has been ordered. The aim of the movement is to make it possible for every patient in all the military hospitals of the United States to listen to radio programs. A large part of the money for this purpose has been raised, and the campaigns are being continued. Similar campaigns for the equipping of non-Government hospitals in various places have been begun.

EXTENSION OF STANDARD RADIO FREQUENCY TRANSMISSIONS

For the past two years the Bureau of Standards has been transmitting at stated times radio signals of standard frequency from the Bureau of Standards radio laboratory at Washington, D. C. These signals are trausmitted approximately twice a month and have been utilized throughout the eastern half of the country. In order to extend the territory covered, transmitting equipment and standards have been installed at Stanford University, Calif., with the cooperation of that institution. The station thus established at Stanford University on September 5 inaugurated the transmission of similar signals of standard frequency, thus duplicating in the West the service rendered by the Bureau of Standards in the East.

The frequencies included in the past transmissions have been from 125 to 2,000 kilocycles (2,400 to 150 meters). In order to make the transmissions of still greater service, they will be extended to include frequencies up to 6,000 kilocycles. The future transmitting schedules which have been definitely arranged are given below.

These special signals of standard frequency are of use to testing laboratories. transmitting station operators, and others in standardizing wave meters and adjusting transmitting and receiving apparatus The accuracy of the frequencies is better than three-tenths of 1 per cent Information on how to receive and utilize them is given in Bureau of Standards Letter Circular No. 92, which may be obtained on application from the Bureau of Standards, Washington, D. C.

All transmissions are by unmodulated continuous-wave telegraphy. 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 "standards frequency signal" just transmitted and contain a statement of the measured 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 schedule of standard frequency signals from both the Bureau of Standards and Stanford University is as follows (attention is called to the change in time, previously announced schedules having begun at 11 instead of 10 p. m.):

Schedule of frequencies in kilocycles

[Approximate wave lengths in meters in parentheses]

Time [1]	Oct. 8	Oct. 21	Nov. 5 [2]	Nov. 20	Dec. 5
10.00 to 10.08 p. m.	1,350 (222)	1,900 (158)	3,000 (100)	125 (2,400)	300 (1,000)
10.12 to 10.20 p. m.	1,420 (211)	2,000 (150)	3,420 (88)	133 (2,254)	315 (952)
10.24 to 10.32 p. m.	1,500 (200)	2,200 (136)	3,800 (79)	143 (2,097)	346 (869)
10.36 to 10.44 p. m.	1,600 (187)	2,400 (125)	4,200 (71)	155 (1,934)	375 (800)
10.48 to 10.56 p. m.	1,700 (176)	2,600 (115)	4,500 (65)	166.5 (1,800)	425 (705)
11.00 to 11.08 p. m.	1,800 (167)	2,800 (107)	5,000 (60)	205 (1,463)	500 (600)
11.12 to 11.20 p. m.	1,900 (158)	3,000 (100)	5,500 (55)	260 (1,153)	600 (500)
11.24 to 11.32 p. m.	2,000 (150)	3,200 (94)	6,000 (50)	315 (952)	666 (450)

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

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 which reached the degree of constancy shown among the stations upon whose frequencies measurements were made in the bureau's laboratory. There is, of course, no guaranty that the stations named below will maintain the constancy shown. As a means of maintaining constant frequency the high-power, low-frequency alternator stations listed below have speed regulators. Most of the broadcasting stations listed use frequency indicators (one-point wave meters) and maintain a maximum deflection of the frequency indicator throughout the transmission. These broadcasting stations, with rare exceptions, vary not more than 2 kilocycles from the assigned frequency. The transmitted frequencies from these stations can be utilized for standardizing wave meters and other apparatus by the procedure given in Bureau of Standards Letter Circular No. 92, Radio Signals of Standard Frequencies and Their Utilization. A copy of that letter circular can be obtained by a person having actual use for it upon application to the Bureau of Standards, Washington, D. C.

Station	Owner	Location	Assigned frequency (kilocycles)	Period covered by measurements (months)	Number of times measured	Average deviation from assigned frequency	Greatest deviation from assigned frequency since Aug. 19
						Per ct.	*Per ct.*
NSS	United States Navy	Annapolis, Md	17.50	13	93	0.2	0.2
WGO	Radio Corporation of America.	Tuckerton, No. A, N. J.	18.85	13	106	0.2	0.1
WII	Do	New Brunswick, N. J.	22.04	12	91	0.2	0.0
WSO	Do	Marion, Mass	25.80	13	90	0.3	
WWJ	Detroit News	Detroit, Mich	580	13	41	0.1	
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C	640	12	60	0.1	0.2
WRC	Radio Corporation of America.	do	640	9	40	0.1	
WSB	Atlanta Journal	Atlanta, Ga	700	12	52	0.1	
WGY	General Electric Co	Schenectady, N. Y	790	15	99	0.2	0.0
WBZ	Westinghouse Electric & Manufacturing Co.	Springfield, Mass	890	5	12	0.0	0.0
KDKA	Do	East Pittsburgh, Pa	920	12	118	0.1	0.0

REFERENCES TO CURRENT RADIO PERIODICAL 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 the professional radio engineer which have recently appeared in technical periodicals. 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, Circular No. 138, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. Further information about these lists, availabilities of previous lists, and of the several periodicals is contained in the extended statement preceding the early lists as published in the Radio Service Bulletin prior to April, 1923, and also in May and September, 1923.

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