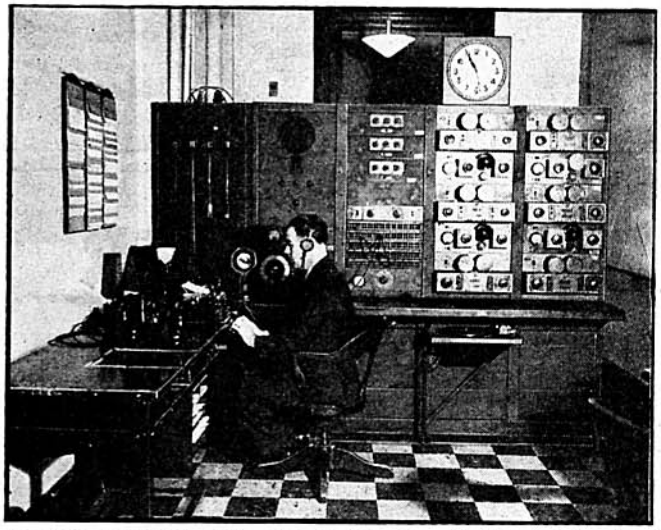
BEHIND THE SCENES OF A

Radio men and those who plan to make radio their business will be interested involved in transoceanic and particularly trans-Atlantic broadcast programs.

EUGENE



The Board at R.C.A.C., 66 Broad St., N. Y. C., through which all international programs are cleared to the networks.

POINT-TO-POINT communication was given one of its severest tests during the Czechoslovakian crisis. In 3 weeks, N.B.C. delivered 110 international broadcasts, C.B.S. made 98 foreign pick-ups, while M.B.S., which made its coverage by play-backs of recorded foreign news broadcasts, contributed 5 European broadcasts—altogether a total of 213 completed and broadcast foreign programs. National differences were forgotten, that the public might be served.

Ignoring the problem of radiophoto work, because it has a few individual problems of its own,[1] one wonders that so many broadcasts could be completed without a serious operating "hitch."

Considering some of the differences we find that a point-to-point radio program service must be more dependable than a point-to-point radio telephonic service. Once a program is sent, it is gone, and there is no re-sending it.

Another difference is that radio programs must be supplied with the high fidelity and quality to which the public is accustomed at the time.

A third difference is the necessity for *cue signals* and *time checks* so that the transition period between programs is passed smoothly, thereby eliminating time waste and poor broadcast technique. A detailed examination would reveal more points of contrast.

RCA COMMUNICATIONS, INC.

Engaged in trans-Atlantic voice communications, R.C.A.C. supplies a point-to-point radio program service which has the characteristic of message privacy given to radiotelegraphic messages. Available only for programs to be used for direct broadcast, the point-to-point transmissions are made in either one or both directions as the client desires; and as such a service the transmissions are made on point-to-point frequencies. All transmissions in this type of service must be directed to a particular point and to a particular party. It must be pointed out that communications are made in both directions only when necessary from the entertainment point of view.

Most of the trans-Atlantic transmissions are sent on short-waves between 4 and 22 mc., and are received on the latest-type diversity receivers.[2] To supply infallible service, all programs received for rebroadcasting are transmitted on TWO frequencies. Both frequencies are connected to a mixer, so if trouble should develop the troublesome frequency can be faded-out and the remaining or "safety factor"-frequency

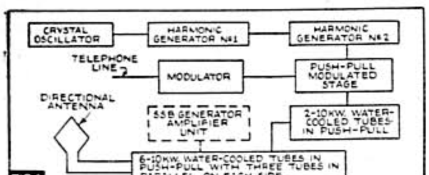


Fig. 1. Transmitter, alternative SSB (single-side-band) unit in dotted lines.

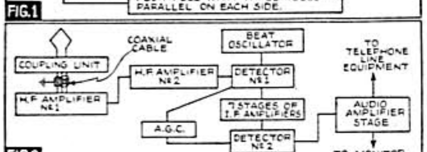


Fig. 2. Block diagram of DSB (double-side-band) receiver.

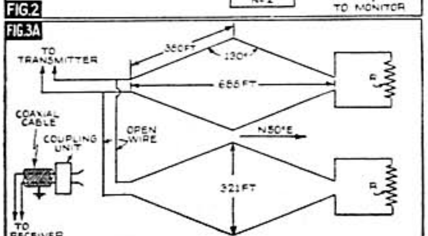


Fig. 3A. Transmitting and receiving antenna details. Resistance R for transmitting, 600-ohm transmission line; R for receiving, 800-ohm carbon resistor.

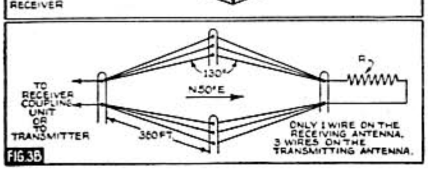
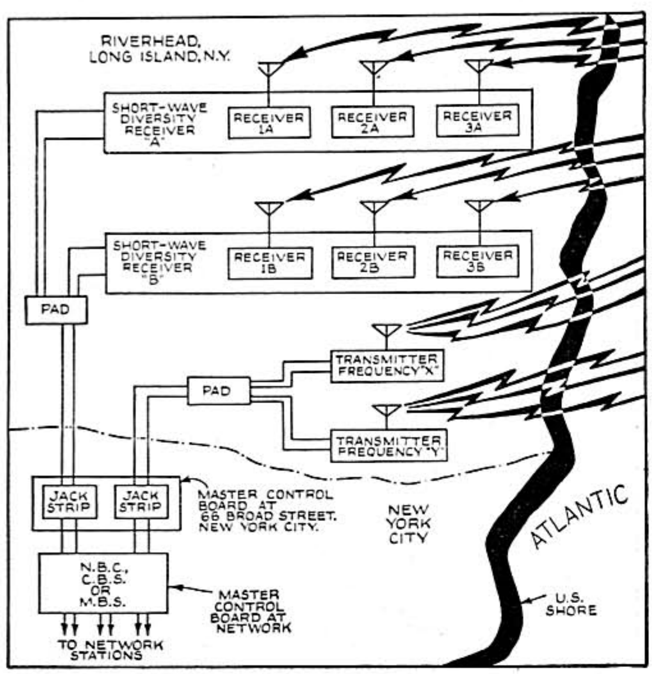


Fig. 3B. Antenna set-up. See Fig. 3A for value of R.



From Riverhead, L. I., International radio programs jump the big pond . . .

TRANS-ATLANTIC HOOKUP

in this absorbing story of how technicians now meet the innumerable problems Important factors are wavelengths, hours and power, and particularly, antennas.

GODDESS

faded in, and the program continued. Since each program is received on 2 frequencies, and each frequency is received by a diversity receiving system composed of 3 receivers, *a single reception of program quality will utilize 6 receivers!*

Most of the European transmitting equipment is pretty much the same as the American. It seems, however, that European companies are beginning to realize that American receivers are superior to theirs, and as a result they are purchasing or making American-designed diversity units.

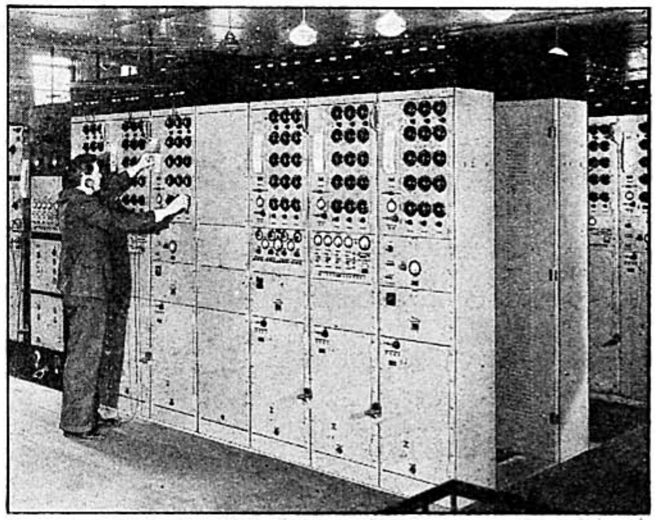
Depending on the time of the day and the frequency used, the power necessary to cross the Atlantic varies between 5 and 50 kilowatts. By working a 5-10 kw. transmitter into an antenna with a power gain of from 10 to 20, R.C.A.C. can attain an equivalent power of 50 kw. in the direction of maximum signal.

At the Rocky Point, L. I., station, "tea-cart" modulators (so called because they are mounted on wheels and can be rolled about like a tea cart) are available to voice-modulate any one of the available radio telegraph transmitters. The station houses more than 20 transmitters.

A European program sent westward goes by land line to the nearest transmitting point. Usually the traffic is confined to a few points, since this practice automatically improves operating technique and decreases time waste. Sometimes, due to changing political conditions, a program may be routed in 3 different ways in as many months.

EXAMPLE

Suppose an American network advises R.C.A.C. that a program is desired from Geneva, Switzerland, at 3:15 P.M., Eastern Standard Time. The responsibility for establishing communications lies with R.C.A.C., which immediately advises Geneva in a service message that on a certain date communications will be established on 2 frequencies at 19:45 G.M.T. to begin tests for a program which will start



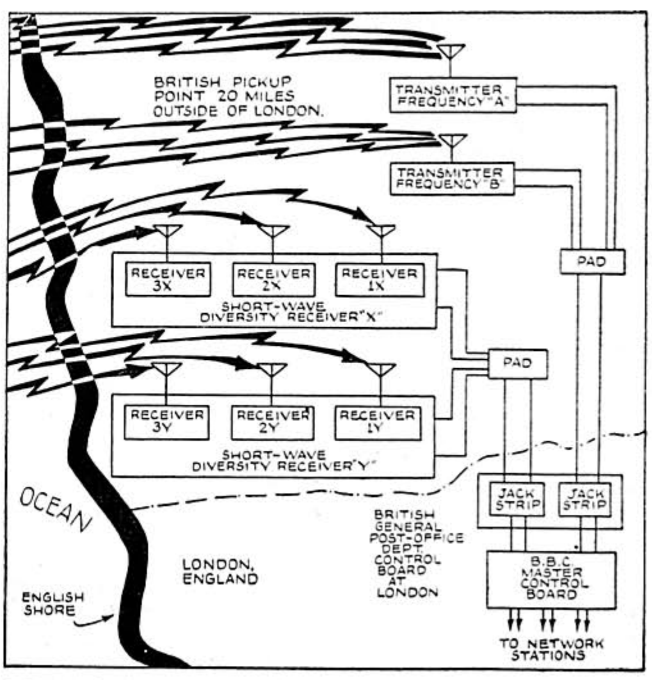
The diversity shortwave radio receiver at RCA International receiving station at Riverhead, L. I.

at 20:15 G.M.T. When the day rolls around, Geneva is called at the time designated over the prearranged frequencies. The receiving station selects one frequency for immediate service, while the other is used as a "safety factor"-frequency being hooked into the fader as previously described.

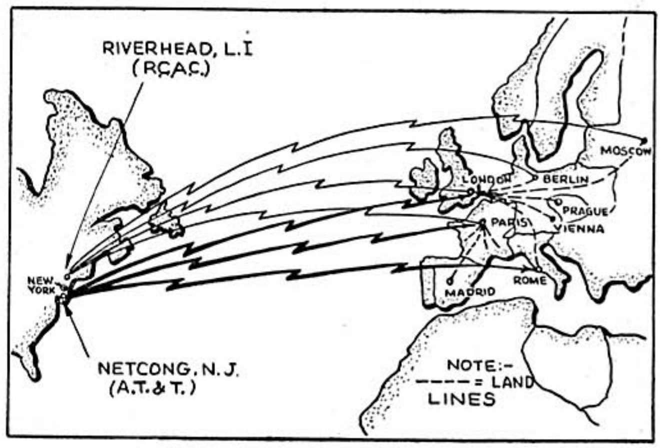
Both frequencies are checked for stability and modulation. A time check is made by the transmitting studio, the Geneva transmitter, the American receiving station, and the American receiving network, to insure that all 4 points are using the exact same time.

Levels are checked at all the important points on the complete circuit. Cues are repeated, the time rechecked, and the testing period is almost up. The stations stand by their respective equipment until the cue is passed, at which time the program starts. The testing period varies in length depending on the program and the circuit conditions. These testing periods are so accurately computed by the experienced transmission engineers, that the standby time between the

(*Continued on page* 238)



. . . to a pick-up point 20 miles outside of London, and thence to Europe.



Radio circuits are shown solid; land lines are dotted. The A.T.&T. station at Netcong, N. J., has radio circuits to London and Paris only. The remainder of Europe is contacted by land lines. The R.C.A.C. station in Riverhead, L. I., has radio circuits to all the capitals of Europe.

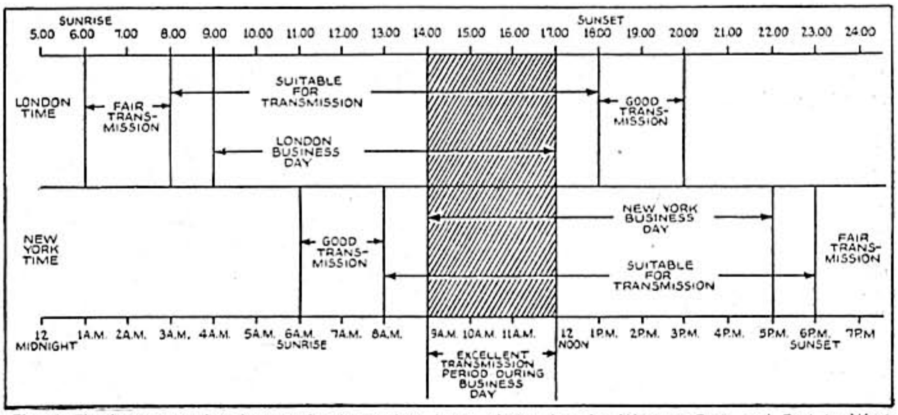


Fig. 4. The best operating frequencies for various hours of the day, for West to East, and East to West transmissions, are shown here.

BEHIND THE SCENES OF A TRANS-ATLANTIC HOOKUP

(Continued from page 211)

end of the testing period and the start of the program is about 1 minute.

Should something go wrong and the Geneva station fail to hear the prearranged cue signal, the Geneva speaker will commence his talk a few seconds after the agreed-upon time. While Switzerland may have trouble in hearing America, the speaker knows he is speaking to America over 2 frequencies and more than likely he is being heard.

The greater part of the communication between the stations is done in voice and in the English language; the remainder is done in code.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Trans-Atlantic radiotelephone circuits of the A.T.&T. terminate in London and Paris. Paris serves as the land terminal for France and its colonies, while the remainder of Europe trafficks its messages through London. All operating is done in English.

With shortwave transmitters located in Lawrenceville, N. J., and longwave transmitters at Rocky Point, L. I., the A.T.&T. continues a service inaugurated in 1927.[3, 4] Two of the available transmitters at Lawrenceville are of the SSB (Single-Side-Band) type, in which the high-frequency components such as pretuned circuits and crystals are selected by means of switches in the low-powered stages.

The DSB (Double-Side-Band) transmitters shown in Fig. 1 are composed of the following 6 stages: (1) The Crystal Stage; (2) The 1st Harmonic Stage; (3) The 2nd Harmonic Stage; (4) A Push-Pull Amplifier Stage; (5) Two 10 kw. Water-Cooled Tubes in Push-Pull; and (6) Six 10 kw. Water-Cooled Tubes in Push-Pull Operated with 3 Tubes in Parallel on a Side. Using low-level modulation the transmitters deliver 60 kw. at modulation peaks when 100% modulated; the unmodulated power output from the last stage is 15 kw.

In the newer type SSB transmitters, the first 4 stages are replaced by an SSB generator amplifier unit which is connected to the 5th stage as is shown in Fig. 1, the SSB being shown in dotted lines. The peak envelope power output of the SSB unit is 2 kw. The use of SSB transmission increases the effective power transmission by 10 times.

The receiving station at Netcong, N. J., has 3 SSB-type receivers, and 7 DSB-type receivers. The DSB receivers have an R.F. gain of over 120 db. Besides the beat oscillator containing 1 tube, the DSB receivers use 13 tubes in the following 12 stages (see Fig. 2): (1) H.F. Amplifier using 1 Tube; (2) H.F. Amplifier using 1 Tube; (3) 1st Detector using 1 Tube; (4 to 10, incl.) Intermediate Frequency Amplifier Stages using 7 Tubes in all; (11) 2nd-Detector Stage using 1 Tube; (12) An Audio Stage using 1 Tube. Mounted in three 19-inch racks, the receiver is 5 feet wide, 6 feet high, and about 1 foot deep.

Since the receiver noise of both the SSB and the DSB is very low the factor limiting reception is usually atmospheric noise.

For transmitting, Twin Rhombic Antennas having their long axis pointed toward London (N 50 E) are joined in parallel. To prevent the antenna from radiating along both directions of the long axis, a 600-ohm resistance in the form of a stainless-steel transmission line is connected at the forwardmost end of each antenna. The antennas, made entirely of open wire, are composed of 3-wire radiators which make common connections at the extremities of the long axis.

Similar to the transmitting antennas in configuration (see Figs. 3a and 3b), the receiving antennas differ in that they consist of a single wire, and the 600-ohm dissipation line is replaced by an 800-ohm carbon resistor, which has the effect of suppressing reception from the unwanted or westernly direction. The antenna is coupled to the receiver by means of a coupling unit and coaxial cable.

THE TRANSMISSION MEDIUM

In general, there are 5 different types of radio transmission path troubles: (1) Magnetic Storms; (2) Fading; (3) Appearance or Disappearance of Signals, due to a shifting of the critical reflected frequency for a given ionospheric layer; (4) Abrupt level change due to change of transmission from one ionospheric layer to another; and, (5) Fadeouts.

Magnetic storms can be overcome by the use of longwave circuits,[5] low-latitude circuits, since the disturbance decreases with latitude, or—if the storm is not too severe —by the use of wide-pattern antennas. From the studies made, the years 1940 and 1941 will give plenty of trouble as far as magnetic storms are concerned.

Another very serious disturbance is the Dellinger Effect, in which the incoming signal is suddenly cut off—as though a switch were opened.[6, 7, 8, 9] The answer to this sort of trouble is to use shortwaves of frequencies higher than those affected. The longwave frequencies are unaffected and may even be improved by the Dellinger Effect.

The quality of the transmission is generally affected by the frequency on which it is made, the higher frequencies being less disturbed by static and noise. The *optimum* (best) *frequency* for a transmission at a given time depends on the time of the day, the time of the year, the status of the solar cycle, and a knowledge of the earth's magnetic currents. In Winter it is better to work the lower frequencies, while in Summer the higher frequencies are more amenable. The Spring and Fall Equinoxes supply the most troublesome periods. At any given instant, it is equally difficult to transmit in either direction.[10]

As far as the time of the day goes, a consideration of Fig. 4 reveals that from 8 A.M. to 1 P.M., E.S.T. are the hours of excellent conditions. Night hour conditions have been found to be more disturbed than those of the daytime. Solar phenomena have been shown to affect radio circuit disturbance on the earth.[11]

Should a solar explosion occur the condition of the ionosphere would be disturbed, and the earth's magnetic condition would be disturbed, these troublesome conditions being reflected by a radio transmission circuit disturbance.

Thus the SUN is a source of trouble in trans-Atlantic communications, where the trend is toward overcoming that obstacle —a trend that has become a parade of communication science.

NOTES

1. **IRE Proc.**, Vol. 23, No. 12, December 1935, Callahan, Shore, Whitaker.
2. **RCA Review**, Vol. 2, No. 1, July 1937, Moore.
3. **AIEE Jour.**, April 1928, Waterson.
4. **AIEE Jour.**, May 1928, Blackwell.
5. **AIEE Trans.**, Vol. 49, p. 621, April 1930.
6. **Electronics**, Vol. 19, p. 25 (1936) Dellinger.
7. **Phys. Rev.**, Vol. 48, p. 705 (1935).
8. **Phys. Rev.**, Vol. 50, pp. 1,189 (1936).
9. **Jour. of Appl. Phys.**, Vol. 8, No. 11, p. 732, Nov. 1937.
10. Terman, "Radio Engineering," p. 644, sec. 128, McGraw-Hill (1937).
11. Same as Note No. 9.

A REAL PORTABLE RECEIVER

(Continued from page 209)

efficiency iron-core I.F. transformers, the loop antenna of comparatively large dimensions, precise values of resistors and condensers, and the use of high-gain tubes. By thus giving special attention to every factor in the design of this portable, it has been possible to obtain an extremely sensitive and selective chassis with good audio output with a plate voltage of only 82 V. The "C" bias for the beam power tube is obtained as the drop across a 720-ohm resistor in the "B–" lead. This circuit arrangement necessitates a ganged switch with one section in the "A+" lead and the other in the "B+" lead. This 2-gang switch is mounted on the volume control.

The diode section of V3 also delivers A.V.C. voltage to the first 2 tubes. The triode section of V3 operates as a first A.F. or driver of V4.

One important factor in making possible the small-space feature of this receiver is the series of Bantam-type tubes. Four of these new small tubes are used

Special batteries had to be designed, to fit the limited available space, in order to secure 82 V. of "B" voltage. This voltage is derived as the total of the "A" supply of 1.5 V., and the "B" battery of 80.5 V. (A 45-V. and a 35.5-V. "B" battery, in series.)

A set of batteries should provide 50 to 75 hours of life, depending upon the type of service in which it is used; that is, whether the portable is used for long periods of time, or whether it is used for really short periods with plenty of time in between for the batteries to recuperate.

Radio-Craft predicts that, now that radio sets are within sight of being really PORTABLE—so that milady can carry them a block without gasping for breath—the battery-portable is destined to "go places" not only in design, but also *commercially!*