

Harbor Craft Ship-to-Shore Radio Telephone Service in Puget Sound Area *

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PUGET SOUND with an area of about 6,000 square miles serves a large region whose principal resources are lumber and fishing. Movement of the raw products to points where the manufacturing and processing are carried on comprises a major part of the short-haul shipping in the Puget Sound area. Large lumber and pulp mills have been permanently established at locations where deep sea shipping and rail facilities are readily available. Logs in the form of large booms are towed to the mills from the sources of supply which extend throughout the area drained by the Puget Sound. The average haul of each boom is about 75 miles and consumes several days. Because of the relatively long time a tug is isolated in each operation, some economical means of dispatching and directing the activities of the tow boats from the land headquarters is desirable. In the case of fishing, there is an even greater need than in the case of log towing for close contact between fishing boat and cannery in order that both the fishing and cannery activities may be coordinated so as to prevent waste of fish during large runs.

From the above, it is clear that some means of communication between harbor craft and land stations would be useful. A preliminary view of the problem indicated that low-powered radio telephone channels from each of these boats to a single land station and thence by wire lines to any telephone, would be the most economical and practical means from the standpoint of the ship owners. Furthermore, the government regulations covering the issuance of operators' licenses for radio telephone transmitters of 50 watts or less power are such that the average member of a ship's crew can qualify after a few hours' instruction, thus making it unnecessary for vessels employing this equipment to carry a special radio operator.

After it was decided that this service was feasible and should be established the initial order of procedure was the selection of the site for the land station.

Due to the fact that it is desirable to locate the transmitter and receiver in juxtaposition, a wide variety of factors had to receive con-

* Digest of a paper published in *Electrical Engineering*, August, 1935, pp. 828-831.

sideration. As to transmission, the distances involved in the harbor area are such as to make it advantageous, from the standpoint of quality and freedom from fading, to make use of a frequency which will permit covering the entire area with the direct or "ground" wave. The signal strengths obtained with ground wave transmission, however,

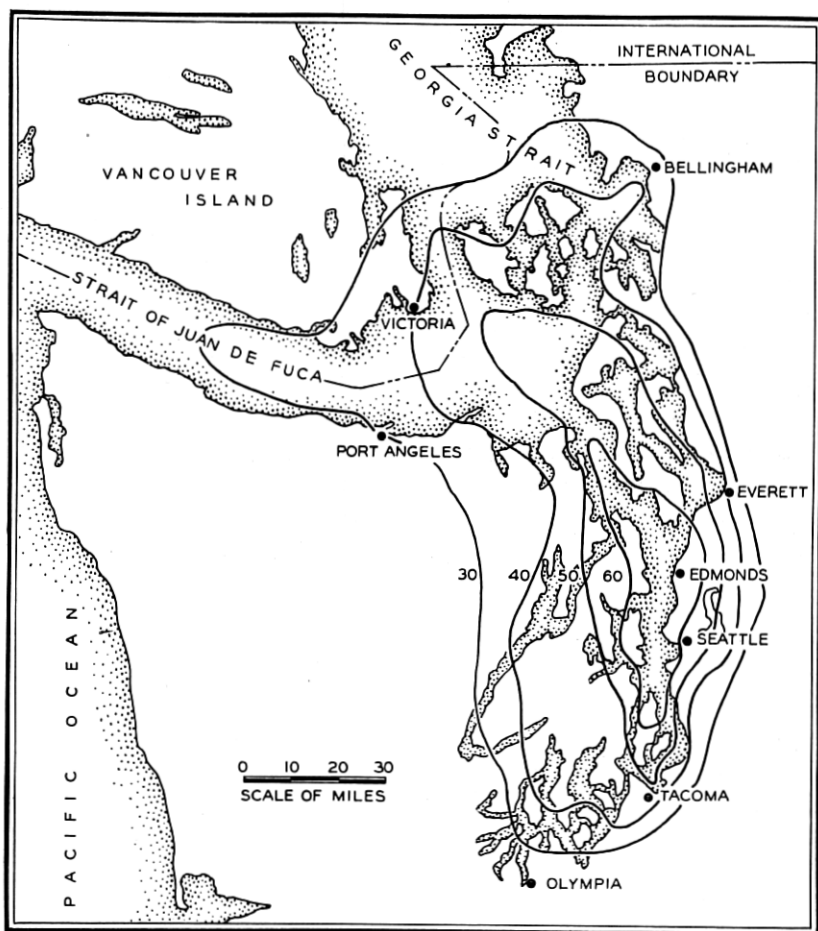


Fig. 1—Field strengths are indicated in decibels above one microvolt per meter.

are affected considerably by the terrain, and the location of the station as much as a mile inland might reduce the over-water range as much as 50 miles. The selection of a receiving site involved a consideration of interference from a variety of sources including high voltage power lines, automobiles and motor boats as well as atmospheric disturbances.

After a survey involving transmitted field strengths and noise measurements, a 13-acre plot of tide and water land having ready access to power supply and telephone connections was selected on Point Edwards about one mile south of Edmonds, Washington, and fifteen miles from Seattle.

Due to the fact that the site for the transmitting and receiving station is under water at high tide, the building housing the radio equipment is of frame construction erected on treated piling.

The transmitting and receiving antennas, located 200 feet apart and near the building are also supported by piling. Both antennas are of the simple vertical type, the former 80 feet in height and supported by a single pole 110 feet high, and the latter 40 feet in height. A tuning unit is mounted in a weather-proofed box on the receiving antenna pole. The transmission line from the receiving antenna to the receiver¹ in the radio equipment building is a special armored and lead covered concentric conductor type.

The equipment at the land station consists of a 400-watt transmitter with a rectifier unit for power supply similar to the type generally used for aviation service. The frequency stability is obtained by the use of a quartz crystal frequency control and will maintain its frequency to better than 0.025 per cent. It is designed for substantially complete modulation of the carrier and under this condition little distortion occurs to the speech frequencies. A tuning unit for tuning the transmitting antenna to resonance is also housed in the building.

As shown on the block diagram Fig. 2, a four-wire circuit is used to connect the radio station and the Seattle office where the circuit becomes two-wire for switching to land subscribers. The equipment includes means for regulating speech volumes; outgoing, so as to always properly load the radio transmitter, and incoming so as to give the shore subscriber the best received volume. A voice-operated device known as the "vodas" provides means for suppressing echoes and singing. This device is essentially the same in principle and in its operation as those used in intercontinental service which have been described in detail in previous publications. In addition to the above units apparatus for monitoring and testing is provided.

The harbor station, moreover, is arranged for remote control operation, equipment being provided so that the transmitter is automatically turned on when the operator inserts a plug in the "Harbor Circuit" jack.

During operation the transmitter is continuously monitored by means of an auxiliary radio receiver in Seattle tuned to the transmitter frequency. In addition, the two-way portion of the voice-frequency

¹ For a description of the receiver see the following digest.

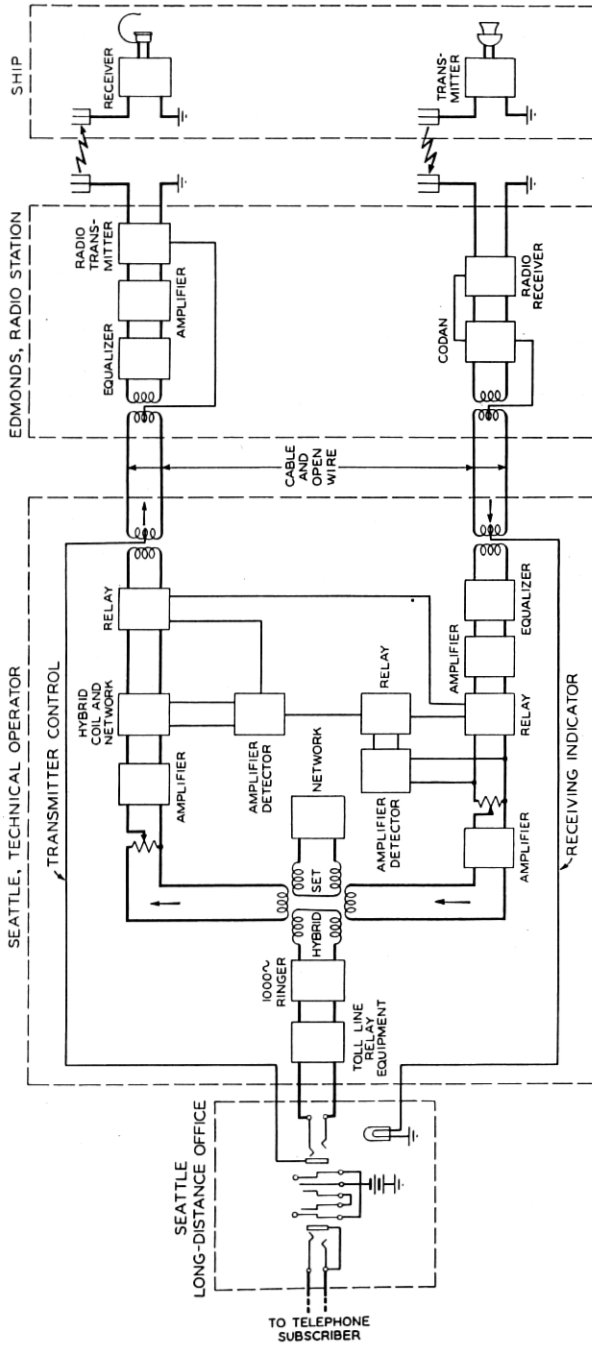


Fig. 2—Schematic of harbor radio telephone circuit.

circuit is monitored by means of an amplifier and loud speaker bridged across the circuit through a high impedance coil. This, of course, indicates to the attendant the general status of each connection as to transmission in both directions. Monitoring by means of a headset is also available and is usually resorted to in those instances where conditions require close attention to the adjustment of the apparatus to insure a satisfactory connection.

When a call originates on land, the toll operator connects the land line from the shore subscriber to the radio circuit, designated "Harbor," by means of a regular toll cord circuit. This operation, which requires the insertion of a plug in the jack of the radio circuit, automatically starts the transmitter at Point Edwards. It also indicates to the radio attendant by means of an alarm that a connection is being made and that his attention is required to ascertain whether any adjustments under his control are necessary for proper operation of the circuit. The switchboard operator then rings with a 1000-cycle signal which registers as an attention call to all ships which have their receivers operating. Selective ringing is available but requires that ships as well as station be properly equipped. The particular vessel to which a connection is to be made is called by name and station letter. This ship then starts its transmitter and reports and the two-way connection is established.

On calls originating from a ship, the boat's transmitter is energized and its carrier operates the codan circuit associated with the land station receiver. An auxiliary circuit actuated by the codan functions to signal the Seattle long distance operator by means of the regular toll line lamp signal. It also signals the radio attendant to stand by in the manner described above. The switchboard operator in responding to the signal inserts the answering plug of a cord circuit in the "Harbor" jack which energizes the land transmitter. Two-way telephone contact is then established with the ship, and from this point on the regular traffic operating procedure is followed in connecting the ship with the desired telephone station.