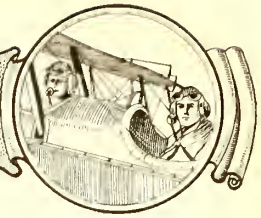
# RADIO DEPARTMENT



# The Submarine's Under-water Radio

IN a general way it is known that during the war a method was found to communicate with a submerged submarine from shore or sea. How this is done and how it came to be discovered that it could be done not until now has been made public. Like a good many other revelations it came when the researchers were at work on another problem.

The scientists of the radio section of the Bureau of Standards stumbled on the secret and the lucky ones to suspect it were two young assistants not long out of high school. Their experiments and the development of what is known as the "loop aerial" for submarine radio communication by the bureau, resulted in a device so simple and perfect, and producing such wonderful results, that the navy has adopted it and is equipping all its undersea craft with this style of loop.

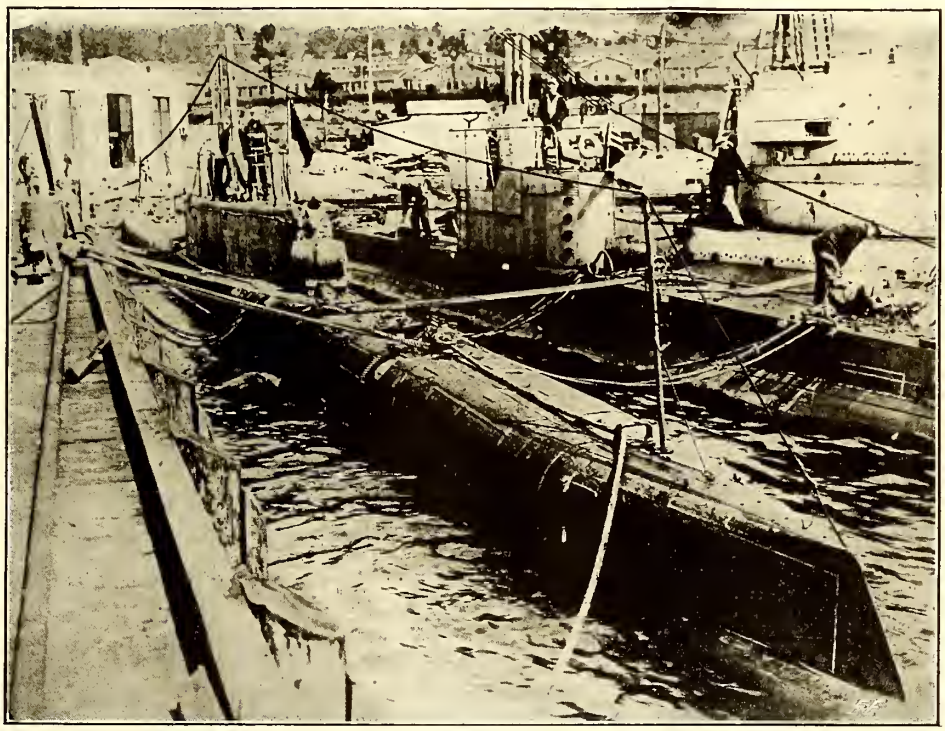
In the fall of 1917 a series of experiments was undertaken by the bureau to develop an apparatus for the detection of enemy submersibles. Mr. J. A. Willoughby and Mr. P. D. Lowell were engaged in the work. They had a notion that a closed "loop" or rubber encased coil of wire offered the best chances for success. They made one and threw it one night into a tank of fresh water on the grounds of the bureau near Chevy Chase, Md., a suburb of Washington. To their delight they received a signal from the big radio station at Arlington. The next night they submerged the coil in the tidal basin of the Potomac near the new Navy Building. Again the signal came with no difference in strength whether the loop or coil was suspended in air or sunk in the river.

#### DISCOVERY OF THE "LOOP'S" EFFICIENCY.

The significance of this discovery struck both young men. Here was a way possibly to detect the presence of enemy submarines, but surely to talk with our own, which was equally important, had been thought impossible. This was in November.

In December improvements in the submerged coil brought the reception of signals from Lyons, France; Paris and San Diego, Cal. By March last year excellent signals were received on a single turn coil 150 feet long by sixty feet high having a wave length range of 100 meters to 15,000 meters. Experiments continued.

In April Mr. Willoughby discust with Lieutenant Commander H. P. St. Clair, of the Radio Division of the Navy, the use of "loops" on submarines for both transmission and reception under water. Both he and Mr. Lowell were sent to New London to work under Commander McDowell in charge of the base, to install the apparatus for a try out on submarine D-1. It is a simple contrivance, the metal frame of the submarine itself being a part of it, this being used as a "ground" just as the earth is used in land telegraphy. The circuit is thus made complete. As finally perfected the loop consists of two insulated wires grounded at the extreme ends of the hull carried over suitable supports to the conning tower and thence thru "radio-lead-ins" down into the boat to the receiving and sending apparatus.



Equipping U. S. Submarines with New Under-water Radio Antenna. The Antenna Comprises the Single, Heavily Insulated Wire Passing from Bow to Stern, Over the Conning Tower. Messages Have Been Received 6,000 Miles When the Loop Was Submerged 8 Feet.

#### SUBMARINE USED AS "GROUND."

A new type of loop was tried on the U. S. S. G-3, in which the lead-in wires were brought in from the upper side of the "loop" instead of the lower and the entire loop was insulated from the hull. Better, but not satisfactory, results were obtained. Up to this time the frame of the boat had not been used as a "ground."

The lower side of the "loop" was removed and the ends of the wire fastened to the bow and stern. The top of the "loop" was submerged eight feet; *signals from Nauen, Germany, were clearly heard.* Very sharp indications of direction were obtained when under water or on top of it. And soon other stations were heard, including *Carnarvon, England, Rome, Italy, and various merchant vessels.* Later experiments showed that communications can be carried on at sea under all conditions more efficiently with the closed "loop" aerial than with the ordinary elevated antenna.

To receive short wave lengths the loop must be near the surface of the water, whereas a wave length of 10,000 meters can be received at a depth of twenty-one feet. Still longer lengths can be heard at greater depths.

#### TRANSMISSION UNDER WATER.

Signals can be transmitted from the loop to a distance of *ten or twelve miles* when the submarine is completely submerged, the maximum distance being obtained when the top of the "loop" is practically at the surface. The distance decreases to two or three miles when the loop is eight or nine feet below the surface. Submergence of the boat during the reception of or transmission of a message does not alter the wave length. If the maximum depth for the wave length being used is exceeded, communication is then interrupted.

The report of the Bureau of Steam Engineering of the Navy Department in its summary of underwater radio experiments says:—

(*Continued on page* 560)

## In October "Radio Amateur News"

Arc Undamped Transmission.
By Ensign P. H. Boucheron, U.S.N.R.F.

Cascade Amplification at Radio Frequencies.
By Thomas Benson

Selector Switch for "Rogers" Underground Antenna.
By Stanley J. Brown

A New Radio Dynamic Controlling System.
By Lieut. W. R. Coventry

Long Wave Receiving.
By H. L. Biedenbender

A Short Wave Receiving Transformer.
By Raymond Evans

Improved "B" Battery Construction.
By J. G. Reed

An Undamped Transmitter of the De Forest Type.
By E. Dynner

Developing Audions for the Amateurs.
By E. T. Jones, Associate Editor

An Exceptionally Well Designed ½ K.W. Transmitter.
By W. H. Priess