How Marconi Has Conquered Fogs With a Lightless Lighthouse

Revealing the Secret of the Wireless Wizard's New "One-Way" Radio Which May Supplant Light Buoys and Other Signal Devices Guiding Ships at Sea

AND now the radio lighthouse!

A real lighthouse, set like a tower on the rocky coast, with searchlight and revolving reflectors, sweeping the sea in every direction with its flashes, just as lighthouses have done in the past, but sending out invisible radio waves instead of rays of light.

A lighthouse whose rays will pierce the thickest fog and enable a distressed ship to find its bearings, even though the ship's own radio transmitting apparatus has been put out of business by wreck or storm.

This is the latest invention of Signor Guglielmo Marconi, which he described fully in a recent lecture before the American Institute of Electrical Engineers and the Institute of Radio Engineers in New York.

Photograph of Marconi's Experimental Lighthouse Erected at Inchkeith, Scotland. At Right, Signor Guglielmo Marconi.

The "secret" of this remarkable new invention has just been fully revealed by Signor Marconi. The statements in this article are based on his own explanation and on simplifying notes supplied by one of America's foremost practical radio experts, Dr. Alfred Goldsmith, of the City College of New York. Ordinary radio signals and messages are carried by long wave-lengths that are sent broadcast—that is, they go out from the instrument in all directions.

The radio lighthouse is based on an invention by which short wave-lengths are used and sent out in a single direction, like the beams of light from a searchlight or a bull's-eye lantern. In the case of light, the thing that concentrates the rays and sends them out in one powerful beam is a combined reflector and lens.

In the case of the short-wave radio signals there is, of course, no lens, but a real "reflector" is used, just as in the case of light rays. Instead of being a concave, shiny surface, it is a concave arrangement of wires, before which the sending instrument is set, just as a lamp or electric light is set in front of a polished reflector.

This reflector is mounted on a revolving tower, operated by machinery, and slowly turns the complete round, sweeping the sea in every direction with its invisible radio searchlight vibrations. By another mechanical device a different code letter is sent out on these uniform wave lengths for each point of the compass toward which the reflector is turned.

When the reflector sweeps a ship at sea the ship's wireless operator can tell, from the particular code letter or signal he is receiving, precisely from what angle or direction of the compass the message is coming.

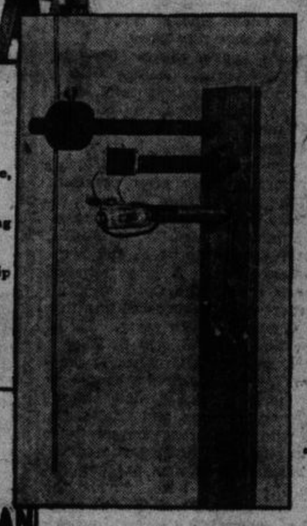
From a second similar radio lighthouse at another point on the coast (signals from two different points are necessary to this process) the ship picks up another vibration. It identifies this and gets its exact angle from the code letter.

With these two signals, by the simplest of all processes of triangulations, the navigator gets his exact bearings. He needs neither complicated instruments nor logarithms nor other mathematical formulas. All he needs is a chart on which the two lighthouses are shown and an ordinary pencil and ruler. He draws a line from one lighthouse at the angle of the compass which the code letter has indicated, and draws another line from the other lighthouse in the same way. The point where the two lines cross is the point where his ship is.

There are already in existence excellent coastal radio signal stations by which ships can get their bearings at sea. One is called the "Radio Compass," and numbers of these stations are now being operated by the navy, both on the Atlantic and Pacific coasts. The other is called the "Radio Beacon," and is operated at a number of points along the Atlantic coast by the United States Department of Commerce.

In the case of the radio compass system, however, a ship, in order to get its bearings, must have both a transmitting apparatus and a special "loop" receiver. Signals must not only be received, but exchanged as well, before the bearing can be taken. In the case of the radio beacon the ship needs no transmitting apparatus, but still has to have the special "loop" receiver.

The loop receiver is a circular coil of wire (shaped like an ordinary coil of rope) wound round a wooden frame. The frame stands on a revolving pivot. By slowly revolving the frame it is possible to tell from precisely which direction the message is coming; the message is faintest when the loop is broadside to it, and strongest when the loop is pointed, edgewise, directly toward it.



Above, Small Experimental Model of the Searchlight Reflector for Radio Lighthouse, and at Right, Short Wave Length Receiving Apparatus, the Only Radio Equipment a Ship at Sea Will Require in Getting Its Bearings from Two Radio Lighthouses.

Diagram Showing How Fog-bound Ship Gets Its Exact Bearings from Radio Signals Projected from Two Lighthouses on Coast.

In the case of the radio lighthouse the ship needs nothing whatever but a receiving outfit of the ordinary kind. It is not necessary for it to exchange signals with the lighthouses. It can get its bearings even if its transmitting apparatus has been completely destroyed. It requires no special loop. It doesn't even need wires strung from mast to mast. The simplest form of receiving equipment is all it needs—a metal bar about ten feet long, cut and clamped in the middle, and a pair of telephone ear receivers.

In describing the invention, for which he gives great credit to the assistance of Mr. C. S. Franklin, a British Marconi engineer, Marconi himself said, in the course of his lecture before the engineering societies:

"As far back as 1899 I showed how it was possible, by means of short waves and reflectors, to project radio rays in a beam in one direction only, instead of allowing them to spread all around, in such a way that they could not affect any receiver which happened to be out of the angle of projection of the beam.

"I also described the tests carried out in transmitting a beam of reflected waves across country over Salisbury Plain in England, and pointed out the possible utility of such a system if applied to light houses and lightships.

"Following those early tests, practically no research work was carried on for years along these lines. The investigation was taken up by me again in 1916, and since that time I have been most valuably assisted by Mr. C. S. Franklin.

"Experiments in Italy showed that good directional working could be obtained with reflectors properly proportioned in respect to the wave length employed. The tests were continued in England and at Carnarvon, Wales. With an improved compressed air-spark gap transmitter, a three-meter wave and a reflector having an aperture of two wave lengths, a range of over twenty miles was readily obtained. (The range has since been more than doubled.)

"Experiments carried out with revolving reflectors, which make it easy to read measurements at any distance, prove that the polar diagram for a given reflector and wave length is practically constant at all ranges.

"The results obtained by reflectors appeared to be so good that I was tempted to try out my old idea of twenty-six years ago, and test the system as a position finder for ships near dangerous points. This is now being done in Scotland through the courtesy of Messrs. D. and C. Stevenson and of the Commissioners on Northern Lights. Trials are being carried out under the supervision of Mr. Franklin with a revolving reflector erected at Inchkeith Island, in the Firth of Forth, near Edinburgh. The transmitter and reflector revolving act as a kind of wireless lighthouse or beacon, and by means of the revolving beam of electrical radiator it is possible for ships, when within a certain distance, to ascertain, in thick weather, the position of the lighthouse.

"The experimental revolving reflector was erected and the first tests were carried out with the S. S. Pharos during the Autumn of 1920.

"The reflector was caused to make a complete revolution every two minutes and a distinctive signal was sent every half point of the compass. It was ascertained on the steamer that this enabled the bearing of the transmitter to be accurately determined within one-quarter point of the compass, or within 2.8 degrees.

"By means of a clockwork arrangement a distinctive letter is sent out every two points, and short signs mark intermediate points and half points; and this is done in practice by contact segments arranged on the base of the revolving signal, so that a definite and distinctive signal is transmitted at every half or quarter point of the compass."

Radio experts are now engaged on plans which may put the Marconi "lightless lighthouse" in use the world over.

The Radio Lighthouse of the Future Showing the Revolving Aerial Wings from Which Radio Code Letters Are Projected, There Being a Distinguishing Letter for Each Different Point of the Compass, and Sectional Interior View Indicating, on Top Floor, Motor Control Room; Floor Below, Reflector Room Containing Marconi's Ingenious Mechanical Device for Automatically Projecting Varying Radio Letters as the Wings Revolve; Floor Below, Radio Room; Floors Below, Stores, Sleeping Quarters, Elevator, etc.