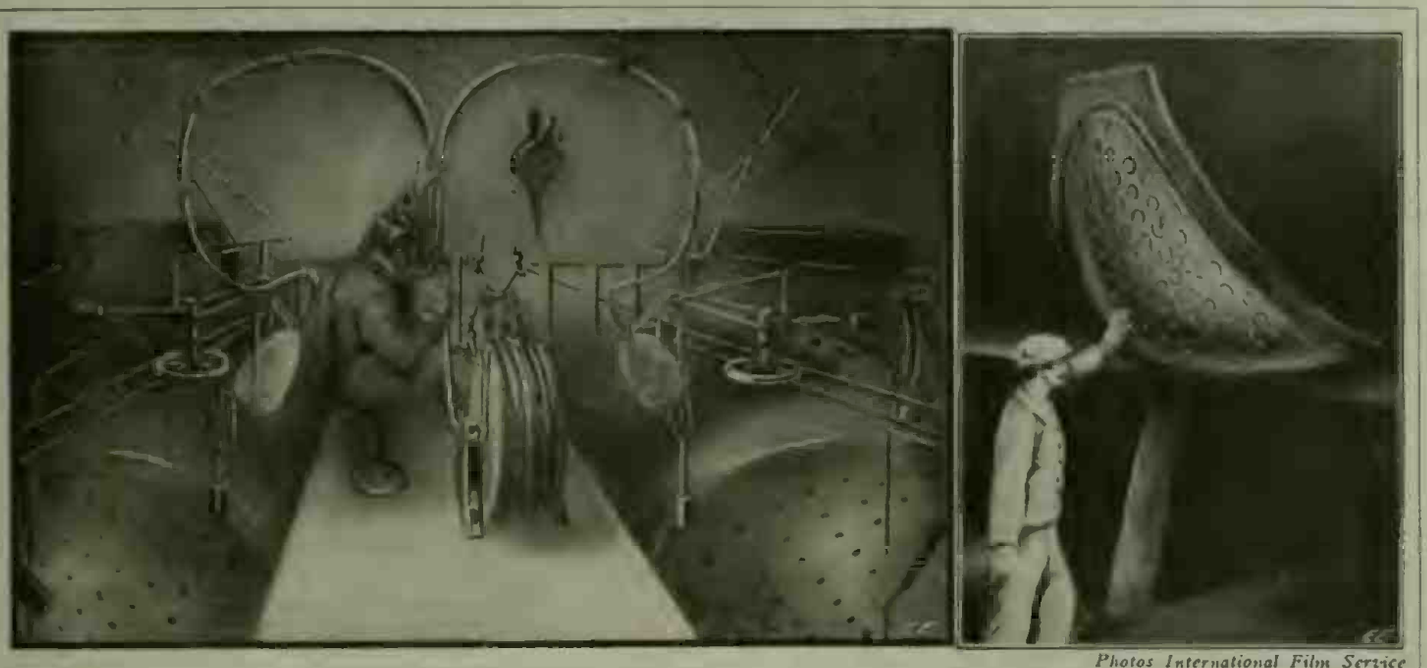
How the French Located Submarines

ONE by one the multitudinous scientific secrets of the great World War are finding their way to the public press, so that the student of science may at last have his appetite appeased in his quest of descriptive matter on some of the master problems which have been worked out and solved by engineers and scientific workers connected with army and navy developments. Probably no one problem in the whole war drew more attention from laymen and scientists alike than did the one of accurately discovering and locating the whereabouts of the Kaiser's U-Boats. The United States Naval Advisory Board received thousands upon thousands of suggestions, all telling how very simple it was to ferret out and locate the position of an enemy submarine, just by placing a microphone or set of microphones in the hull of a vessel and connecting these up with a set of telephone receivers, so that the sound produced by the submarine propeller and motor would be picked up by the microphones and thus heard in the receivers. Various methods were described for taking certain definite and very precise measurements along these lines, so as to work out mathematically or otherwise the position of the lurking sub-sea fighter. Considerable success was obtained with similar arrangements by the navies of the different countries participating in the World War, but the Walser gear—a special type of hydrophone used particularly for listening to submarines under water was developed and successfully used by the French Navy and other allied vessels for accurately locating enemy submarines at distances of one mile to three miles or more, depending upon the operating conditions and the size of the submarine.

The Walser Gear, whose construction has been kept secret during the war, is a directional apparatus for detecting and recording sounds heard thru water and thus locating the presence or approach of enemy ships. Many different devices for "listening" for enemy ships have been disclosed, but this apparatus, the invention of Lieut. Georges Walser, of the French Navy, is recognized as the most improved type and most practicable.

The sounds are received thru a number of vibrating diaframs fitted into holes pierced in a boss, or "blister" of sheet steel, which replaces a corresponding section of a ship's hull. The observer works in a sound-proof cabin stretching across the whole width of the ship, and wears a listening helmet attached to two trumpets. Into these trumpets the sounds are focust by the vibrating diaframs attached to the the "blister."



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The Walser Gear—a Type of Hydrophone Used for Submarine Listening. The Walser Gear, Whose Construction Had Been Kept Secret During the War, Is a Directional Apparatus for Detecting and Recording Sounds Thru Water and Thus Locating the Presence or Approach of Enemy Ships. This Apparatus is the Invention of Lieut. Georges Walser, of the French Navy, and is Recognized as the Most Improved Type and Most Practicable. The Sounds are Received Thru a Number of Vibrating Plates Fitted Into Holes Pierced In a Boss, or "Blister" of Sheet Iron, Which Replaces a Corresponding Section of a Ship's Hull. The Observer Works In a Sound Proof Cabin Stretching Across the Whole Width of the Ship, and Wears a Listening-helmet, Attached to Two Trumpets. Into These Trumpets the Sounds are Focused By the Vibrating Plates Attached to the "Blister." Left:—Detecting the Presence of Enemy Ships On or Under the Surface of the Sea. An Observer Using the Walser Gear in a Special Cabin Fitted Up as a Listening Post. Right:—On the Hull of the "Henriette II", a French Warship Which is Using the Apparatus, Showing the Exterior of the Sound—Collecting Boss or "Blister".

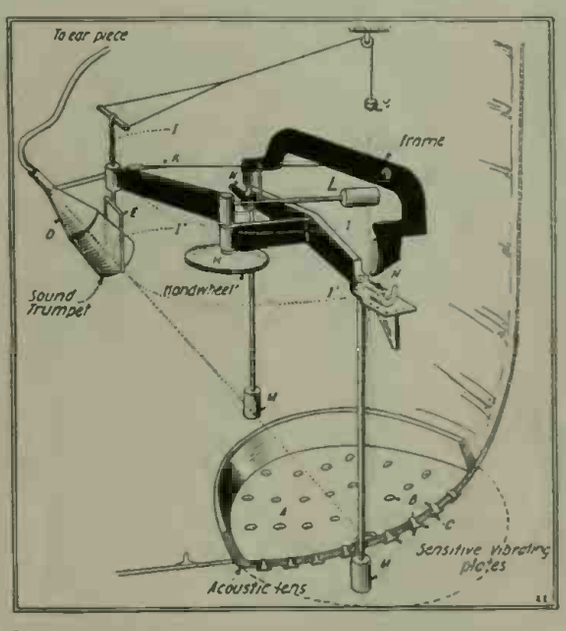

Diagram of One "Lens" of the Walser Submarine Detector and Locater, Showing the Carefully Worked Out Balancing Scheme for Supporting the Movable Sound Trumpet Over the Various Sound Focal Points.

Some of the disadvantages of the ordinary listening microphone arrangement for the detection of submarines are the following: Invariably the vessel on which they are mounted has to be stopt momentarily while a listening test is being made, in order that the ship's engines shall not drown out the sounds which the listening operator is endeavoring to pick up from the sea. It is interesting to mention in this connection, that some of the American listening devices of this type were so remarkably sensitive that even a small dynamotor used on the regular wireless apparatus on the vessel had to be mounted on springs, so that the extremely slight mechanical vibration set up by it would not interfere with the sounds picked up from the water on the submerged microphones fastened to the hull of the boat. Another fault found with the ordinary "hydrophone" is that the different sounds received simultaneously could not be distinguished very readily from one another, and even if but one sound was picked up, the direction from which the sound emanated was not very perfectly indicated.

Practically speaking then, one of the

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major problems, if not indeed the predominant one, to be met with in working out a more selective and accurate form of submarine listening device was that, whatever its form, it should be susceptible of operating and functioning on any vessel while it was under full headway, and further, that the indications given by the instrument of the direction of such sounds should be sufficiently accurate to permit the commander of the vessel on which it was installed to set a straight course for the indicated spot where the submarine lay in wait for its prey. Contrary to general opinion, many authentic instances are on record where submarines were surprised in this way during the war and sent to the bottom, sometimes by armed merchantmen or converted yachts, and again by fast destroyers or submarines. The English in particular seem to have obtained very gratifying results in fighting the U-Boats with their own submarines.

Lieut. Walser designed his apparatus after first carefully studying a well known, yet heretofore overlooked, principle of physics, viz: that sound, identical to light, upon passing thru one medium into another, is *refracted*. The orthodox theory concerning the complex light beam or ray from a given object states that they comprise a number of component waves, which may be considered as parallel when their source is situated a sufficient distance, and which parallelism is upset only when an obstruction is placed in their path, when they are thus caused to enter a new medium having a density of a different value from that in which they were propagated. Lieut. Walser had the forethought to perceive that sound waves must follow the same theory. To prove his theory, he interposed in the path of sound waves a device which would respond to various vibrations, and which formed what we might term an *acoustic lens*. As has been found in explaining the theory of light transmission, a similar effect takes place in sound transmission thru the air or water and other mediums, and the result of thus interposing such an acoustic lens or vibrating member causes the individual waves composing the complex wave propagated from a given source to come to a focus. This has the two-fold effect of intensifying the individual waves and also of isolating them precisely from other sounds emanating from the sources foreign to the one being localized. Naturally, the different sources of sound will create a corresponding number of foci, of which the geometric focus can be ascertained by mathematical computation. In a similar manner from the position of the sound focus which corresponds to any individual source of sound, the definite direction of that source can be readily estimated.

The accompanying illustrations show the "Walser submarine detector" gear as installed on French vessels, and the detail view shows how the sound detecting lenses, which are fitted into large steel bulges or "blisters", secured to the hull of the vessel, are connected to two trumpets, which may be traversed in a circle above them, so as to accurately localize the various sounds heard from different vibrating diaframs comprising the lenses. One trumpet picks up and localizes the sounds from the *port* lens, and the other the sounds picked up and intensified by the *starboard* lens. The spherical segments supporting the multiplicity of lenses is indicated by *A* in the detail figure. This segment is provided with a circular series of openings, *B*, each of which contains a sensitive vibrating diafram, *C*. The general effect of this arrangement is to focus all of the sounds picked up, the focal points all lying on a circle, *I*. As aforementioned, the vessel fitted with this apparatus has two of these lenses, one to *port*