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Electrical Device Detects Submarines 20 Miles Away

THE long sought for solution of the submarine detection problem has apparently arrived in the form of a specially tuned microphonic device which is placed below the surface of the water along the coast line, and in the following paragraphs the general principles utilized in exactly detecting and locating the position of a submarine, when it is totally submerged, are explained.

The American electrical engineer, William Dubilier, recently returned from France, has developed this "submarine detector" to a high degree, and in his research work he had the co-operation of Prof. Tissot, the noted French scientist. A properly designed microphone or sound-operated instrument, which will translate sound energy into a corresponding electrical current, forms the nucleus of this remarkable invention which, it is said, has aided in doing away with a formidable number of German "U" boats around the French and English coasts. When sound waves impinge against the diaphragm of a microphone (which corresponds in general to that fitted on an ordinary telephone apparatus with which we are all familiar), it causes a variation of the inherent electrical resistance of this instrument, owing to the different pressures exerted against a number of small carbon balls, placed in a cup back of the diaphragm.

Contrary to the general opinion which might prevail in such a case, it is not the sound of the propellers or the engines of the submarine that are heard best, according to Mr. Dubilier, but the high humming note produced by the electrical motors utilized in propelling the submarine when submerged beneath the surface of the sea. Thus a most important point is gained, for if it were the former which emitted the sound waves used for the successful operation of this latest scientific device, the possibilities are that very little success would be attained, as the engines are not used except when cruising on the surface. It has been found that if the microphone is placed in a properly tuned resonance chamber, located about 20 feet below the surface of the water at the shore testing station, this particular humming note reverberated by the entire metallic shell of the submarine, can be selected and then intensified by means of suitable amplifiers, such as the well-known Audion type, developed by Dr. Lee de Forest.

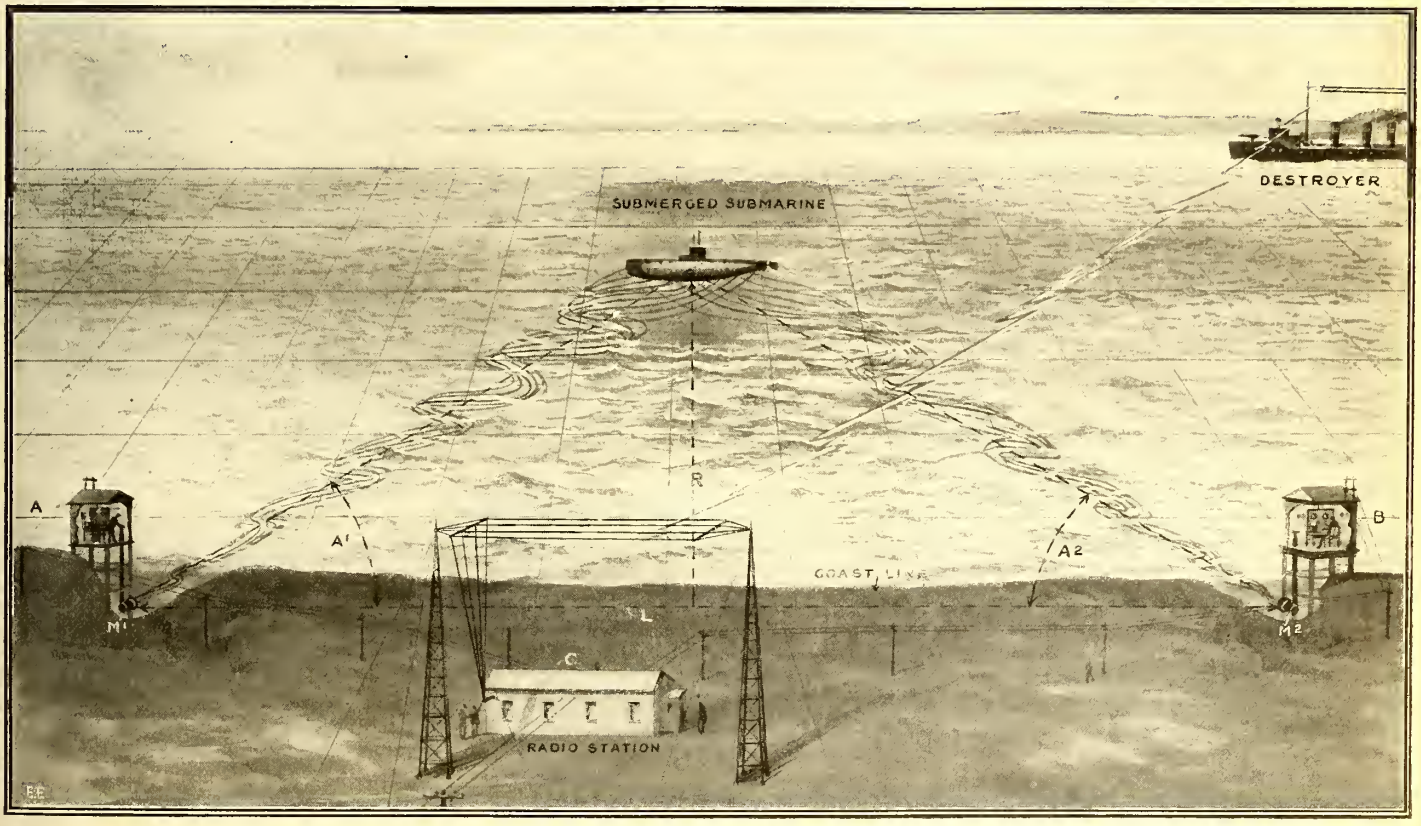

Fig. 1. Diagram Showing How Science Now Locates Submarines, Even When Submerged, by Means of Sensitive Electrical Ears That Pick Up the Peculiar Note They Emit.

This particular note, so effective in the successful operation of Mr. Dubilier's instrument, has been found to have a frequency period of about 750 cycles per second. The illustration herewith shows the inventor of this clever scheme for detecting submarines, holding one of the super-sensitive microphones, and, also Fig. 2, shows a detail photograph of the microphone proper. Several methods for filtering out the extraneous sound waves trans-

mitted by passing steamers and the like were successively tried out, but the best method of all was ascertained to be the one embodying the use of resonance tubes, incorporated in the shell containing the submerged microphone. In this way it was found possible to closely tune the micro-

William Dubilier, the American Engineer, Has Perfected for the Allies a Successful Submarine Detector. He is Here Observed Holding the Super-Sensitive Microphone Used.

phone chamber, so that it would respond to the vibrations of the order above mentioned only, or to any desired harmonic of this frequency. These have proven very successful and are now being used by all submarine detecting stations located on the English and French coasts.

The resonance chamber, tunable to any desired musical note frequency, and in which the microphone proper is placed, is shown in Fig. 3. This consists of a stout outer steel chamber A, in front of which is placed a metal diaphragm B. Even at a very little submerged depth the water pressure against the diaphragm is severe indeed, and to counteract this, compressed air is fed into the chamber A, to offset this water pressure on the exterior casing. The diaphragm B is rigidly supported in the heavy outer chamber, which is pivotly mounted on the directing rod, as observed. There

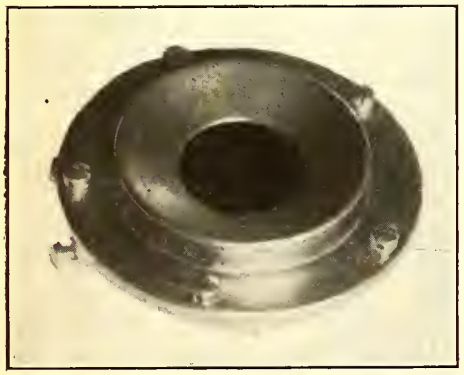

Fig. 2. Appearance of Sound Detecting Microphone Which, Submerged in the Waters Along the Shore, Indicates the Presence of Undersea Craft.

is carefully fastened to this a steel resonance tube, which consists of two distinct tubes, one sliding within the other so that it may be adjusted for any note desired. Both of these tubes have diaphragms in them, as perceived from the sketch, and in the same way as an organ pipe vibrates at different frequencies, depending upon its length; so this resonance tube vibrates to some particular note, depending upon how far apart the diaphragms in same are situated. Hence this remarkable device will not only respond to one particular note accurately, but it will, owing to the phenomenon of resonance, respond with maximum efficiency to that note, and in this way the microphone is affected in the most powerful manner possible for any given signal or sound wave. Flexible and heavily insulated wires lead up from the microphone to the operator in the detecting station, located on the ground above. In this station is located the Audion amplifier apparatus, as well as the telephonic and telegraphic instruments for communication with the wireless station and with the second detection station.

The large illustration, Fig. 1, here portrayed, gives a general layout of the scheme, as it is applied in practice. As observed, a submerged submarine is seen progressing from right to left across the view. Of course, if the submarine should stop its propellers and likewise its motors or engines, and submerge to the bed of the ocean, or bay, no sound would be heard. But, on the other hand, it could not very well start up the propellers and get away without being at once detected by the observers stationed at the various shore stations. The underlying principle governing the detection and accurate location of a submerged submarine is based on the same methods as used in modern long distance gun sighting. Let us assume two detecting stations at A and B, respectively, and at a certain known distance apart, as indicated by the line L. Also that these stations are telegraphically or telephonically in communication with a wireless station C, as well as with each other. Now when the operator located at station B rotates his submerged microphone by means of a suitable shaft and gear arrangement, etc., until the incoming submarine note is heard loudest (or, as a matter of fact, as soon as he hears the note at all), he immediately notifies the operator at station A of this fact. Operator A then endeavors to tune in the submarine's note to a maximum value, and when both A and B have their instruments so set that the note is heard at maximum strength, then the angles A_1 and A_2 are definitely known from the calibrated dials fitted to the microphone controlling shafts. It is now a simple matter to make the calculation (usually by means of a slide rule, specially constructed), to find the exact range or distance R, between the submarine and the base line L.

Also to facilitate matters in this respect, the water is definitely laid out in squares, as indicated by the lines in the drawing. These lines, of course, are only imaginary, but they are exactly plotted on the maps used by the military authorities in charge. All these squares are numbered and, therefore, it is an easy matter to give explicit directions through the wireless station C, to a waiting torpedo boat destroyer so that this terror of the submarines may proceed quickly to the exact square in which the submarine is to be found. The under-water craft may be moving into a second or third square from that first communicated to the commander of the torpedo boat destroyer, but that is a small matter and is checked up constantly by A and B and then transmitted to the commander through the wireless station; thus keeping him acquainted with the definite whereabouts of the under-sea boat every few minutes.

In most cases the submarine, after a short while, comes to the surface to make observations, as otherwise it is running blind so far as events above the surface of the water are concerned. In a remarkable number of instances this method has worked, it is said, with wonderful success, and as soon as the submarine came to the surface, it took but a few moments to either destroy or capture it by means of the destroyer, which was on the spot at the instant the submarine shoved its periscope above the surface of the sea.

So we see that while the submarine has been developed to a wonderful degree, in so far as range and other features are concerned, there has been devised by scientists a method to counteract their efficiency. In less time than it takes to tell, a torpedo boat destroyer may be despatched to the exact spot where the submarine is so peacefully pursuing its way and, as it supposes, unseen and unknown.

Or, again, it is possible to send an aeroplane to the scene, equipped with powerful explosive bombs. On the latest type of these aerial bombs, designed for the destruction of submarines when under water, there is provided fluted tails which cause them to go straight down into the water for a considerable distance without deviating from the point originally aimed at. The aeroplane has proven one of the best detectors of submarines when it happens to be known where the submarine is located. Although not generally known, it has been definitely proven that the observer in the aeroplane flying at a considerable distance above the water, and regardless

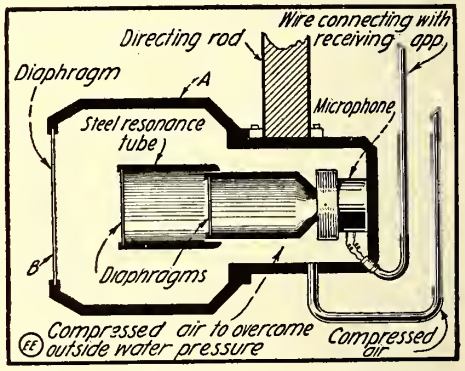

Fig. 3. Details of Specially Contrived "Resonance Tubes" and Microphone Arranged in Stout Water-proof Shell.

of the wave formation on the surface, can detect accurately the presence of a submarine even though submerged 75 to 100 feet below the surface.

It may be said in conclusion that these marvelous submarine detectors have not proven satisfactory for use on ship-board, but this point will probably be overcome in the near future. This is accounted for by the noise and severe vibration encountered on the vessel itself on which such apparatus has been installed. However, it has proven a Godsend to those responsible for the protection of the water adjacent to the English and French coasts, and it is hoped that the United States Government will not be dilatory in recognizing the merits of this most ingenious device which has been the goal of many hard-working engineers and scientists in the United States and abroad for a number of years.

Wellesley College girls will eat electrically prepared food in their new central dormitory. The new wing is equipped with a special three-oven 12-foot range and a bake oven with a capacity of 90 one-pound loaves. The equipment will serve 250 students and help.