

Hunting Submarines with a Sound Detector

American Invention That Played an Important Rôle in the War Against the U-Boat

By Brewster S. Beach

AFTER nearly two years of the closest censorship, the United States Navy Department has given approval to the publication of certain data relating to the development in the United States during the war, of submarine detecting devices, which were used to signal advantage by this country and the Allies in prosecuting and bringing to a successful conclusion the campaign against the German U-boat.

The apparatus may be termed the composite work of the General Electric Company, Submarine Signal Com-

cable to the operator who was located in the ship's hold.

A third adaptation of the listening principle was an instrument which protruded through the hull and was a stationary part of the vessel's equipment. A somewhat similar device was constructed for use on submarines, but all of them were used to advantage. Phonograph records of various sounds heard by the observer were made and catalogued, preserving a complete record of the accomplishment of the detector. These records were used in training students to distinguish between submarine and surface craft.

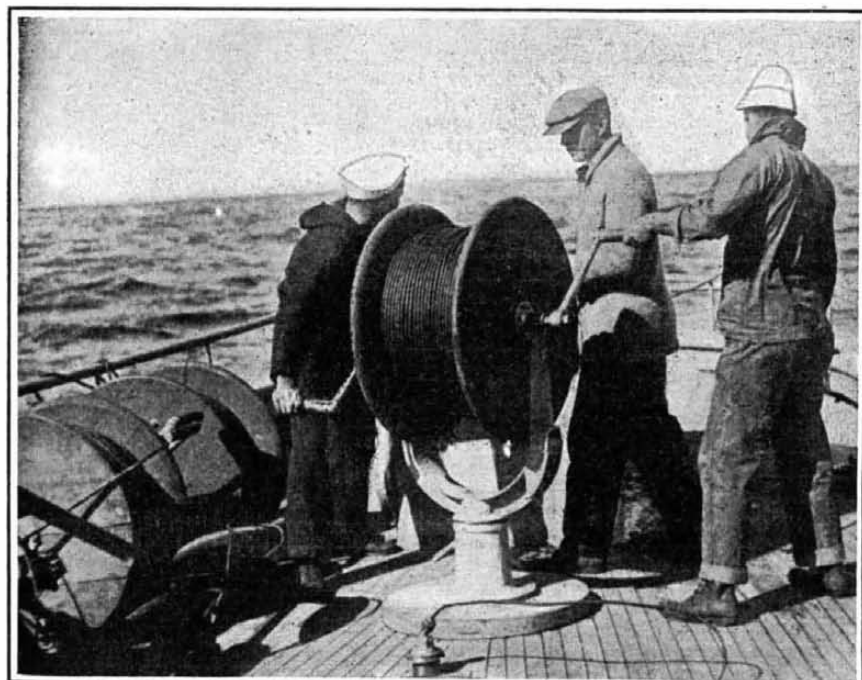
abroad, the American submarine detectors were universally adopted by all the Allied navies.

It was found to be much superior in many ways to any of previous development, and came to be considered one of the most effective offensive weapons ever used against the submarine. It is only necessary to recount a few pertinent points to illustrate the practicability of the device.

Under ideal conditions with extraneous noises reduced to a minimum or entirely eliminated, the device was effective at a range of from 15 to 25 miles. Under average circumstances, the device was good for a range of between 3 and 8 miles. Trained operators could clearly and invariably distinguish between the sounds made by approaching surface craft and underwater vessels (submarines). Within five miles the engine characteristics of different vessels were clearly marked even to the point of identifying by name certain (unseen) vessels after they had been observed previously for more than one time. (This test was substantiated by a series of night time experiments at the entrance to Boston harbor in September and October 1917.) It was found practical to tell when a submarine changed from her oil engines to electrical drive which was necessary every time the vessel submerged.

The direction of sound could usually be computed within a very few degrees of its actual location and a good judgment of the distance could generally be made. This was proved to the satisfaction of all concerned following a number of practical tests off Cape Cod, Mass., in the late summer of 1917, in waters adjacent to Boston and in Long Island Sound.

While in fairness to all of the sound detecting devices developed during the war period, it must be said that the American device was inferior in certain respects when it came to the application of these devices under actual battle conditions, but in heavy sea and weather they stood up re-



Using a trailer to remove the receiver from the noises of the ship's own engines

pany, Western Electric Company, the National Research Council, assisted and advised by many eminent scientists, engineers and research men, chief among whom were Drs. W. R. Whitney, Irving Langmuir and W. D. Coolidge, Prof. R. A. Milikan, Prof. Max Mason, etc.

Realizing that the prompt solution of the submarine problem was the key to a successful termination of hostilities, Secretary Daniels, immediately upon our entrance into the conflict, appointed a special board to devise ways and means to overcome it.

At the suggestion of Dr. Whitney, a group of scientists was formed at Nahant, Mass., under Dr. Irving Langmuir, where the results of extensive research activity were put to practical tests under actual conditions as nearly as possible approaching those in European waters.

Another group under Prof. Milikan, head of the Physics Department of the University of Chicago, was organized at New London, Conn., where the work of both bodies was later coordinated.

Out of the efforts of these two groups and the work carried on in Schenectady, assisted by Allied commissions of scientific men, there grew the American Submarine Detector—a development of the old principles of sound wave transmission in water in an altogether new and startling manner.

The apparatus, finally perfected and put to immediate use, was first designed to hang overboard from naval craft amidship below the water line and it depended for its direction getting qualities on the peculiar and heretofore little understood faculty of the human ear to detect the direction of sound by the shifting of that sound from one ear to the other.

Owing to the interference of sounds made by the listening ship's own motors, it was found more practical to stop the engines when about to take observations and this added greatly to the effective range of the instrument.

To overcome this obstacle, another device was developed which could be trailed off the stern a hundred or so feet away where the engine noises of the ship were out of range and the sound was then brought in by electric

Fitting Aircraft with Sound Detectors

While demonstrating the device to the British Admiralty, our American engineers were asked to study the question of fitting submarine detection units to airplanes, balloons and dirigibles.

After some experimentation, followed by more practical tests and conferences with the Lancashire Group

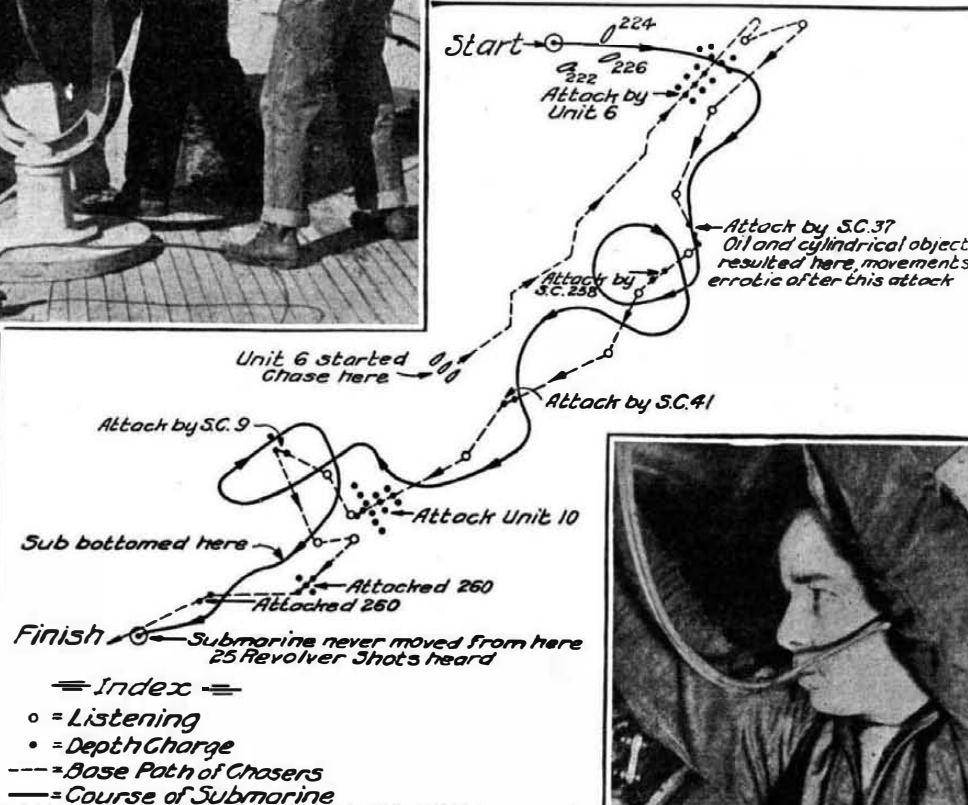
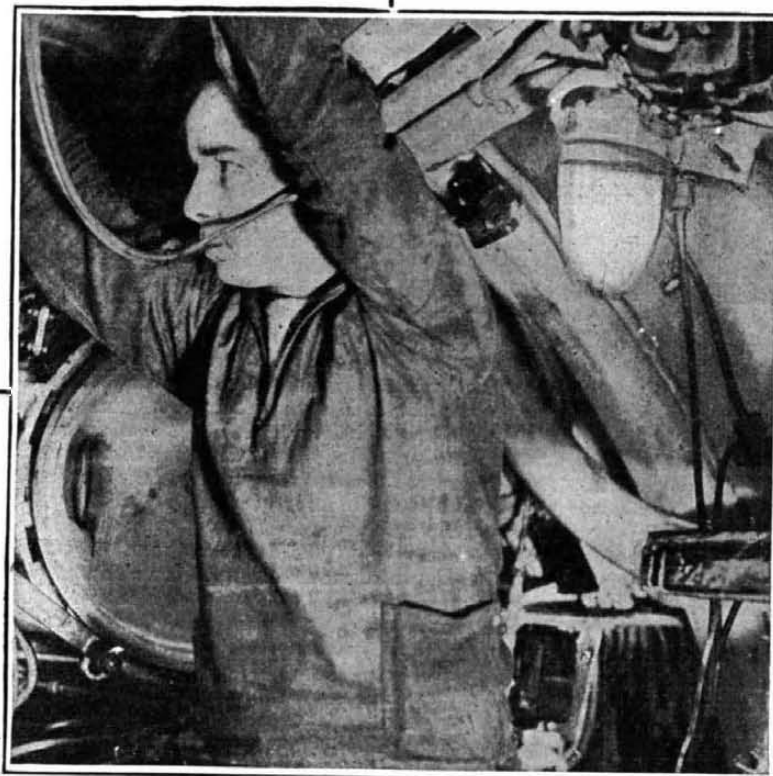


Chart of an actual pursuit of a U-boat which ended in the destruction of the submarine

of scientists at Harwich, apparatus was developed which met these needs and many aircraft were equipped with sound detectors which rendered it possible for them to follow the course of the enemy after they had seen her submerge, a valuable faculty which such craft did not possess until the introduction of the American detector.

Permission has not yet been obtained to enter into a detailed description of the devices invented during this period. The Government, having spent large sums of money on the apparatus, desires the intricacies of its manufacture still kept secret, while other matters involving several American concerns, makes discretion the better part of valor in attempting to tell the inner secrets of its development.

However, when the devices had proved themselves eminently satisfactory after exhaustive experimentation here, the Navy Department organized a special Service Party under Capt. R. H. Leigh of the Bureau of Steam Engineering to demonstrate the detectors to the British Admiralty. Shortly after the arrival of this party



Using the listening device in an American submarine

markedly well. This factor was of especial value during operations in the English Channel and the North Sea, which has been termed the roughest body of water for its size in the world.

The addition of these listening devices to submarines added the heretofore lacking sense of hearing to all the underwater craft and made them at once a much more effective weapon of offense. An Allied submarine on one occasion chased a German U-boat for four hours, while both craft were submerged, without once losing

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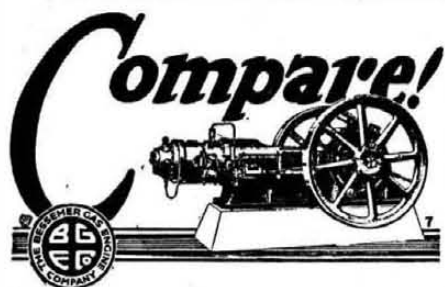
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worm; but it has been done. In one district of the Seychelles Islands, for instance, every one of the 740 houses now has an approved latrine, though only seven were so equipped when the work began. The suggestion that this statement refers to European residents can easily be disposed of by citing the fact that for the entire archipelago the white population is but 600. And what has been done in Seychelles has been done—in small areas, to be sure, but none the less effectively for those areas—in the West Indies, in Siam, in Costa Rica and Nicaragua, in our own southern states. Perhaps in the last named locality the problems of the workers were as acute as anywhere, because here there was to be combatted not alone popular ignorance and indifference, but actual hostility against interference with the liberty of the individual. Yet in 66 of the 300 communities in the South where this sort of work was conducted within a certain period, not a home was left without an approved latrine; the percentage of houses so equipped before the campaign was, for these communities, 76.

So much for prevention. In addition, it may be news to a good many of our readers that a specific cure for hookworm has been in use for several years. The campaign against the pest has had more or less publicity, but we do not recall that this particular aspect of the case has as yet been touched upon in any save medical publications. The facts are, really, somewhat amusing. The worm occupies the intestine; the logical remedy is therefore to cause the patient to evacuate his unwelcome guests. But the worms are so firmly attached to the walls of the intestine that they resist with great success the action of ordinary purgatives.

In this dilemma, it occurred to the Rockefeller Institute's searchers that if the worms could only be paralyzed, they would "lose their grip" and be passed easily enough. Two drugs were found which have this happy effect upon the parasites, while at the same time producing no serious results in the case of a patient who was suffering from no organic weakness aside from the direct ravages of his hookworms. So the program of treatment consists of a dose of thymol or of chenopodium—just now the latter is preferred—to reduce the worms to helplessness, followed by castor oil or some other purgative. One treatment is seldom completely effective; but the most virulent cases have yielded to three or four, at appropriate intervals. In fact, based on the proportion of worms harbored to worms removed, a single treatment of chenopodium is found to have an efficiency of 96 per cent.

With sufficient time and sufficient funds and sufficient workers, it is accordingly well within the possibilities that the International Health Board, which is conducting the anti-hookworm work, will succeed in the practical eradication of this long-standing menace. What such success will mean to the world is suggested by the estimate of an engineer who places the discovery of this treatment second on the list of benefits to the human race which have been contributed by individual members thereof since the dawn of time.

Hunting Submarines with a Sound Detector

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sound contact with the fleeing enemy. The graphic chart published herewith will indicate to the reader, the ability of submarine chasers to maintain sound contact with the enemy and the efficiency of the direction qualities of the devices when used in this manner.

Chasing a U-Boat to Its Death

The engagement which it illustrates occurred one early morning in the English Channel. A small squadron of submarine-chasers discovered an enemy craft moving slowly up the Channel submerged. Forming for the attack they rushed over the spot where their listeners indicated the



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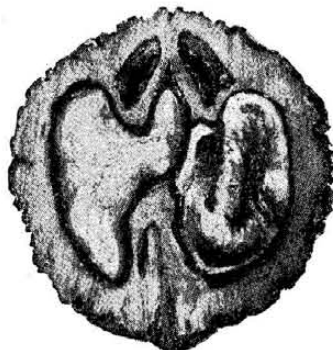
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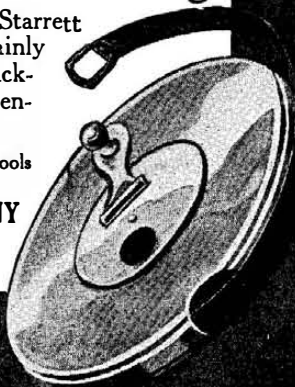
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U-boat to be, dropped a pattern of depth bombs and then withdrew to take observations.

Feverish activity and the sound of hammers ringing against the ship's side was heard. The submarine motors would then start up and stop, start and stop again.

Further attacks were delivered and more noise came to the listeners from the hold of the submarine. Evidently the first depth charge had taken good effect and the enemy's crew was making a last desperate effort to reach the surface. Then there was a dead silence broken at last by 25 sharp reports like revolver shots. The crew, giving up in despair, had committed suicide. The loss of this submarine was later substantiated by the British Intelligence Department.

When Capt. Leigh and his party went abroad in November, 1917, he requested the Admiralty to loan him two high speed chasers in which operations could be begun in English waters, but was finally obliged to accept 3 trawlers of 9 to 10 knots speed, because of the scarcity of higher speed craft at that time.

Equipping these vessels with all of the anti-submarine detecting apparatus, they went out in the English Channel on New Year's Day, 1918. Shortly afterwards a wireless message was picked up from an airship giving the position of a submarine which had just been seen to submerge. The Channel had been laid out in numbered squares to facilitate the immediate location of enemy craft and the little squadron steamed over, got their devices out and picked up the submarine's course.

When believing themselves about over the enemy, depth bombs were discharged and later a trawling instrument was used which indicated that the submarine had been destroyed. Great quantities of oil rising to the surface also substantiated the success of the attack.

Remaining in English and French waters for several months, where the American devices proved of great value and were highly complimented both by Admiral Sims and British Naval Officers, another squadron was equipped and sent into the Mediterranean and Adriatic where at this time submarine activity was at its height.

The Barrage Across the Straits of Otranto

Because of the deeper water and less interference from surface traffic, listening conditions were unusually good. A barrage line of boats was organized across Otranto Straits, between the mainland and the Island of Corfu, to put an effective stop to the enemy's free entrance to the Mediterranean.

The German submarines leaving Pola were obliged to go through Otranto Straits to get to the Mediterranean, and once through they had things practically their own way, as there were very few patrol boats in the Mediterranean. The tonnage sunk during the first three years of the war shows the condition that existed before the Otranto barrage was put into effect.

Our submarine chasers while on barrage were constantly in sound contact with enemy submarines, especially at night, as they usually attempted to get through during the dark hours. They would run down on the surface at their maximum speed and could be heard for an hour or two before they came to our line. The difference of sound between an oil engine and an electric motor is so marked that it was comparatively easy to tell when they changed from one to the other which was necessary as soon as they submerged. As they knew approximately where our line was they invariably submerged two or three miles before they reached the line.

The course of the submarine was plotted to scale by the flagship of a unit from bearings given to it from the other two boats and also from its own bearings. When the submarine had approached sufficiently close, the unit was got underway and maneuvered into position for attack. The

attack was usually made when the submarine was 400 or 500 yards ahead and all three boats of a unit steaming full speed ahead, would lay a pattern of depth charges over the area where the plotted position showed the submarine to be.

Three of the chasers patrolling in formation abreast one dark night heard a submarine approaching. The bearings obtained by the two beam vessels pointed directly toward the center boat. The middle boat now heard the submarine approaching from a position dead astern. The enemy came nearer and nearer and finally passed right under the sub-chaser so close to the surface that those on board felt a wave of water along the keel of their ship.

When the German had passed on and out in front, the attack was made in unison, a pattern of depth bombs was "let go" and the little fleet halted for further observations. Pretty soon the whirl of the submarine's electric motors was heard evidently in an effort to reach the surface.

Then came a crunching noise not unlike the popping in of a blown up paper bag. It was apparent that the submarine had been damaged, put out of control, and sunk and that she had collapsed from the tremendous water pressure at these depths.

Many incidents of this kind occurred during the subsequent operations in foreign waters and several submarines were accounted for through the direct aid of the American listening devices.

In fact, naval experts who were closely in touch with submarine detection development during the war period, state with conviction that if the conflict had continued through another summer, the submarine would literally have been driven from the ocean, the promise of a condition due in a large measure to the perfection of submarine detecting apparatus.

It has also been stated that the noticeable change in naval tactics—from defensive to offensive—which marked this country's entrance into the war was largely caused by the application of American principles to the pursuit and attack of the U-boat, something made possible by the practical use to which it was found the American submarine detector could be put.

Foreign Trade in Furniture

SEVERAL phases of the war and peacetime activities of the Forest Products Laboratory at Madison, Wis., have a bearing on the problems of shipping furniture overseas. These cover the conditioning or preparation of the wood to suit the climate to which the furniture will be sent, the use of waterproof glues, kiln drying, boxing and crating for overseas shipments, and possible treatments to prevent depredations of wood destroying insects. While information is at hand on general principles, the application of these principles to the needs of the furniture industry has never been studied, and cannot be undertaken without the cooperation of manufacturers.

In general, it can be stated that furniture manufactured in the north central states will check and open up when sent to desert regions, and that its wood will swell, the glue joints open up, and the veneering come off when it is sent to tropical humid regions. Exact knowledge of the climatic conditions surrounding the use of the furniture at its destination, and a reproduction of these conditions in the factory through the control of humidity in work rooms, should offer the successful solution of this problem. This would be coupled with consideration of drying the lumber to the proper moisture content, and shipment in moisture-proof packages to insure delivery in good condition.

It is felt that the Laboratory can be of considerable assistance to the furniture industry along these lines, should the manufacturers care to take advantage of the facilities available.