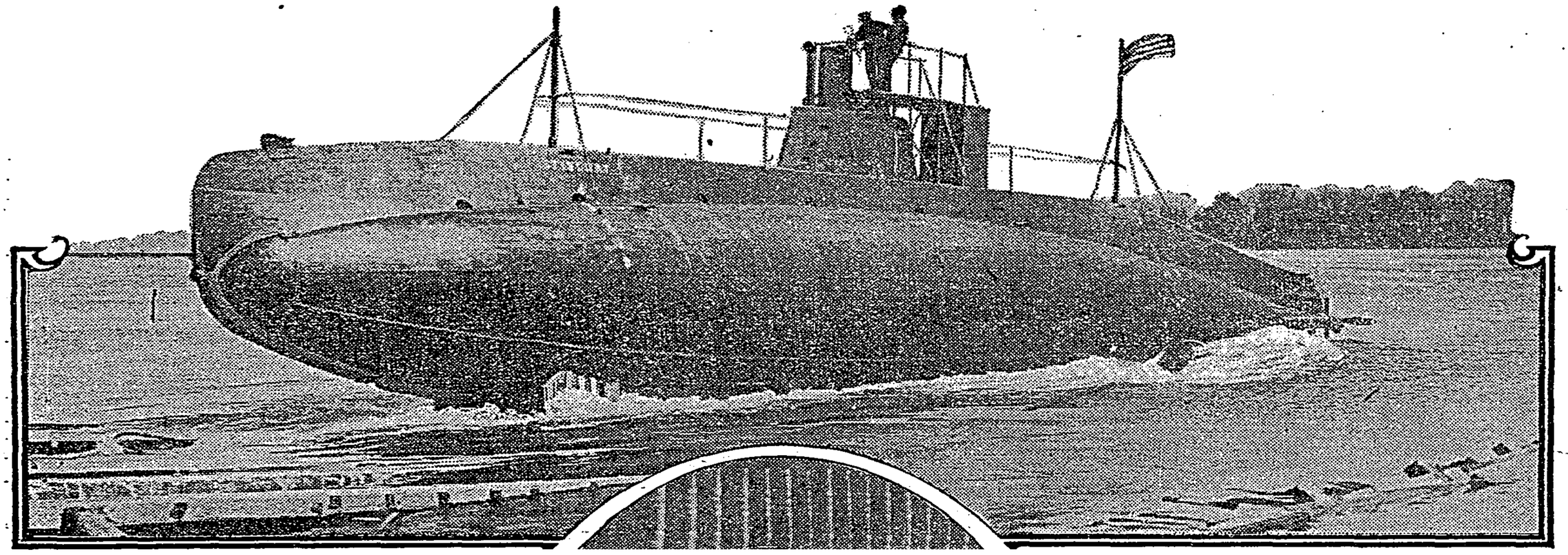
EDISON LESSENS SUBMARINE PERIL



Octopus type of U S Submarine

If His New Storage Battery Does What Is Claimed for It, It Will Double the Efficiency of This Modern Type of Fighting Craft.

New Device Expected to Extend Cruising Range of Underwater Craft Over 150 Miles and Do Away with Poisonous Gases.

THE announcement made last week that Thomas A. Edison had perfected a battery which is to be submitted to drastic tests in the newest of American submarine craft now building, the L-8, at the Portsmouth, N. H., Navy Yard, is the first authoritative information that the inventor is interested in solving the health and power problems of underwater fighting machines.

Much has been said connecting Mr. Edison with the submarine by officials in Washington and elsewhere, but until last week the inventor himself steadily declined to say a word. Now the announcement has been made by Miller Reese Hutchison, Mr. Edison's chief engineer and personal representative, that a superior style of submarine storage battery has been evolved.

So it may be said that Edison, the man opposed to war and its implements, has perfected a battery which will not only make the submarine habitable by preventing asphyxiation of a crew in the event of a prolonged enforced submersion, but will practically double the strategic efficiency of submarine craft by providing it with a storage battery which will extend the undersea cruising range to 150 miles, the present radius being less than 100 miles.

Although the submarine has been steadily developed during the past fifteen years by countless inventions increasing its efficiency as a fighting machine, little good has been accomplished in making it habitable. Great sums have been spent to secure an adequate ventilation of the vessel when submerged. The heated air of the engine room and the exhaled air of the crew have been drawn off, filtered, oxygenated, cooled, and returned to the interior, but even this intricate process has failed to rid the boat of poisonous gases. Mr. Edison has attempted since 1910 to improve these conditions by getting at the exact source of trouble—the batteries.



Edison, holding his commercial type of storage battery.

Secretary Daniels of the navy gave the public the first intimation that Mr. Edison was lending his genius toward the submarine when he said last December, before the House Naval Committee:

> Submarines have given us more trouble than anything else in the navy. Submarines are fickle—getting out of order any time—and we have yet to find a successful type of battery and engine. The lead casings around the battery are liable to be eaten out by the sulphuric acid in the batteries. Then the steel surrounding the lead is eaten through and the salt water from the submerging tanks gets in and chlorine gas is generated, which is very dangerous to the crew. * * * Mr. Edison proposes to use an alkaline solution in the cells of his battery and thus eliminate the danger to the lead casings and the steel partitions.

So imminent, indeed, is the danger to life from these lead-sulphuric acid batteries now in use in all our submarines that an ex-navy officer, when asked recently if he would volunteer his services in the event of hostilities, said:

"That would depend entirely upon the nature of the duty. If I could be reasonably sure either of complete annihilation or absolute safety, I would go. The probability of 'passing out' does not worry me, but I do draw the line on becoming an invalid or a cripple—a burden to myself and family for the remainder of my days."

No other problem of the submarine has so persistently asserted itself as the battery. If the battery is not in good working order, the submarine cannot be operated beneath the surface. The battery is the heart of a submarine, just as the periscope is the eye. When running on the surface the vessel is propelled by an ordinary gasoline engine, and running thus, with the conning tower open and the ventilators at work, air is forced into the boat, which, mixing with the gasoline, engenders the necessary combustion to run the ship. But when submerged the boat must necessarily be sealed. Access to the outside air is accordingly shut off, and the ordinary gasoline engine cannot be used. At this time, therefore, an entirely different source of power is called into use, namely, electric motors, deriving their energy from electric storage batteries..

Only last year the submarine E-2 was running from Newport News to New York when the commander smelled the familiar odor of chlorine gas. This gas is to the commander of a submarine exactly what fire-damp is to a miner. Instantly the commander gave orders for the tanks to be emptied, that the submarine might rise. Upon reaching the surface—and luckily enough the sea was calm—the hatches were opened and the crew ordered on deck. Despite the dispatch of these relief measures the gas had got in its deadly work, and two of the crew had hemorrhages from the lungs. A call by wireless was sent out and the boat was towed back to port, where an examination of the ship's batteries revealed a typical condition of affairs.

In the type of battery employed on the E-2, a type employed on all our submarines, sheets of lead are suspended in sulphuric acid, within a hard rubber jar, hence the name lead-sulphuric acid batteries. These jars are in a compartment surrounded on all sides by the ship's main ballast tanks into which salt water is admitted and expelled. Once this sea water is mixed with sulphuric acid, hydrochloric acid fumes are formed. When the salt water finds its way to the

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Miller Reese Hutchison, Edison's Chief Engineer, Talking to Lieutenant Archibald Grahame Sterling of United States Navy, Brother of Yates Sterling, Commander of the Submarine Flotilla.

interior of a lead storage battery and combines with the material on the lead plates, chlorine gas—one of the deadliest known gases—is generated.

This is exactly what had happened on the E-2. By some means, a slight crack, perhaps, or unusual strain, sulphuric acid had escaped from one of the jars, and, attacking the steel of the ballast tank, had eaten through, so that when the tank was filled the battery itself was flooded.

The dangers from chlorine gas are even yet more serious. Just before the submarine D-1 was going out for a cruise an inspection was held, which disclosed the fact that the acid had eaten its way to the gasoline tank and that the batteries were flooded with gasoline. Had the vessel been under way at the time it would have taken but a single spark to ignite the gasoline and cause an explosion.

All these dangers are at once done away with by Mr. Edison's new battery. It not only prevents asphyxiation, but it acts as a disinfectant because of the affinity of its solution—potash—for carbonic acid gas. There is enough potash solution in the batteries alone, says Mr. Hutchison, to purify the air for 100 days or more.

It is a fact of peculiar significance that Mr. Edison's first visit aboard a warship occurred in December last at the Brooklyn Navy Yard, when he visited the battleship New York in company with Rear Admiral Fletcher and Secretary Daniels. At this particular time one of the inventor's new batteries was being put to a severe test in the basement of the Administration Building. The battery was placed on a specially designed cradle and was rocked to and fro, in imitation of the rolling motion of a submarine. When Mr. Edison saw the battery going through its rolling motions he turned to the man in charge of the test.

"Make her rock faster!" he shouted. "Give her a big tip. Bump her. Do anything you want with her. I've tried everything and you can't faze her!"

Shortly thereafter Secretary Daniels announced from Washington that Mr. Edison was busy with his new battery for the submarine.

Before the inventor allowed his battery to be sent to the navy yard, or before he even considered the manufacture of it, he sent it to Mr. Bachmann, the General Superintndent of the laboratories, with these instructions:

1. Mount cell in cage of apparatus. No cushioning whatsoever between the cell and cage. Run the apparatus continuously until the cell has been raised three-quarters of *an inch and dropped on a solid block* two million times.

2. There must be no sediment in the bottom of the can after this test and the cell must have as great electrical capacity as before.

3. Secure cell to truck and project truck against a brick or stone abutment five hundred times at a speed of fifteen miles an hour at moment of impact.

His battery met these tests as easily as it met the one later on at the navy yard. The navy officials found out, as did the inventor himself, that "you can't faze her."

But to go back still further. The new submarine storage battery is an adaptation of the commercial type of Edison battery now in worldwide use. It cost him seven years of labor and the expenditure of over $2,000,000 to perfect this battery. He started with the idea well fixed in mind that nature could certainly afford one more reaction for the production of electric current without the use of dangerous acids. The enormous, almost unsurmountable, detail which had to be carried through is almost beyond belief. Over 50,000 separate experiments were made, and the results of each carefully tabulated and plotted as curves before the final battery was evolved. The curve sheets alone, if placed end to end, would be sixteen miles long, or they would cover two acres of ground.

After innumerable experiments he at last struck upon a reaction, which, although it appeared weak at the beginning, was very promising. This one reaction was followed with most intense persistency for fully three years, before even the first unimproved type of nickel-iron-alkaline battery was produced. Any storage battery consists of a positive and a negative plate submerged in a jar in a liquid known as the electrolyte. Its value is dependent upon the fact that the elements of this combination are changed chemically by passing a current through them, but in such a way that the attempts of nature to bring back these elements to their original condition produces electricity.

The greater the surface presented by the plates, the greater the current produced. The positive plate of the Edison cell is composed of vertical rows of thin, perforated steel tubes, filled with nickel hydrate, these tubes being supported by a very light steel frame. The electrolyte is a solution of potash. At this point it can be said that the Edison battery differs from all other batteries; in fact, it is the only battery the elements of which are not attacked by the solution in which they are submerged when left standing in a charged or discharged condition for an indefinate period.

The battery, stated simply and concisely, is composed of but four things—nickel, iron oxide, and steel, in a solution of potash—and surprising as it may seem, the potash is a preservative of all the elements entering into the combination; thus the battery elements do not destroy each other. Sulphuric acid attacks steel; potash preserves it. The acid battery is a generator of noxious and, at times, deadly fumes. The Edison battery is fumeproof, gasproof—a hermetically sealed containing can making it so. Even if the potash gases could escape they would do no harm. Potash is an excellent disinfectant. Mr. Edison has explained this as follows:

When a storage battery is charged, hydrogen gas forms on the negative plates and oxygen gas on the positives. These gases, in the form of minute bubbles, rise to the surface of the solution and, being lighter than air, float away. Being formed in and subsequently passing through the electrolytes these minute bubbles convey each a small quantity of whatever chemical the solution is composed of; if they are formed in a lead-sulphuric acid type battery, sulphuric acid is the cargo; if in an Edison battery, potash.

When these bubbles rise from the surface of the electrolyte and come into contact with an object they either remain until evaporation disintegrates them and deposit their charge of acid or alkali, or they burst and accomplish the same result. The gas vent of a lead type cell is open and the bubbles may therefore pass through freely and away. The vent of the Edison cell is a check valve. To get out, the gases must lift this valve by pressure formed within the otherwise hermetically sealed containing can. If these potash gases were allowed to get out they would do no harm, for they purify the air.

No better proof of the healthfulness of the Edison battery is afforded than at the West Orange works, where several thousand cells are charged and recharged with hundreds of workmen around them. The executive offices of the plant, and, in fact, Mr. Edison's library, are but a few yards from the storage battery building. Not so with lead-sulphuric acid batteries, however. They are manufactured as far away from the main works as possible, and powerful electric fans are used to remove the fumes.

Navy specifications covering the installation of lead-acid batteries stipulate lead-lined rooms to retain them, and lead-lined ventilating pipes with specially constructed and installed motors to operate the exhaust fans. In specifications covering the installation of Edison's new battery no mention need be made of lead-lined rooms or exhaust fans.

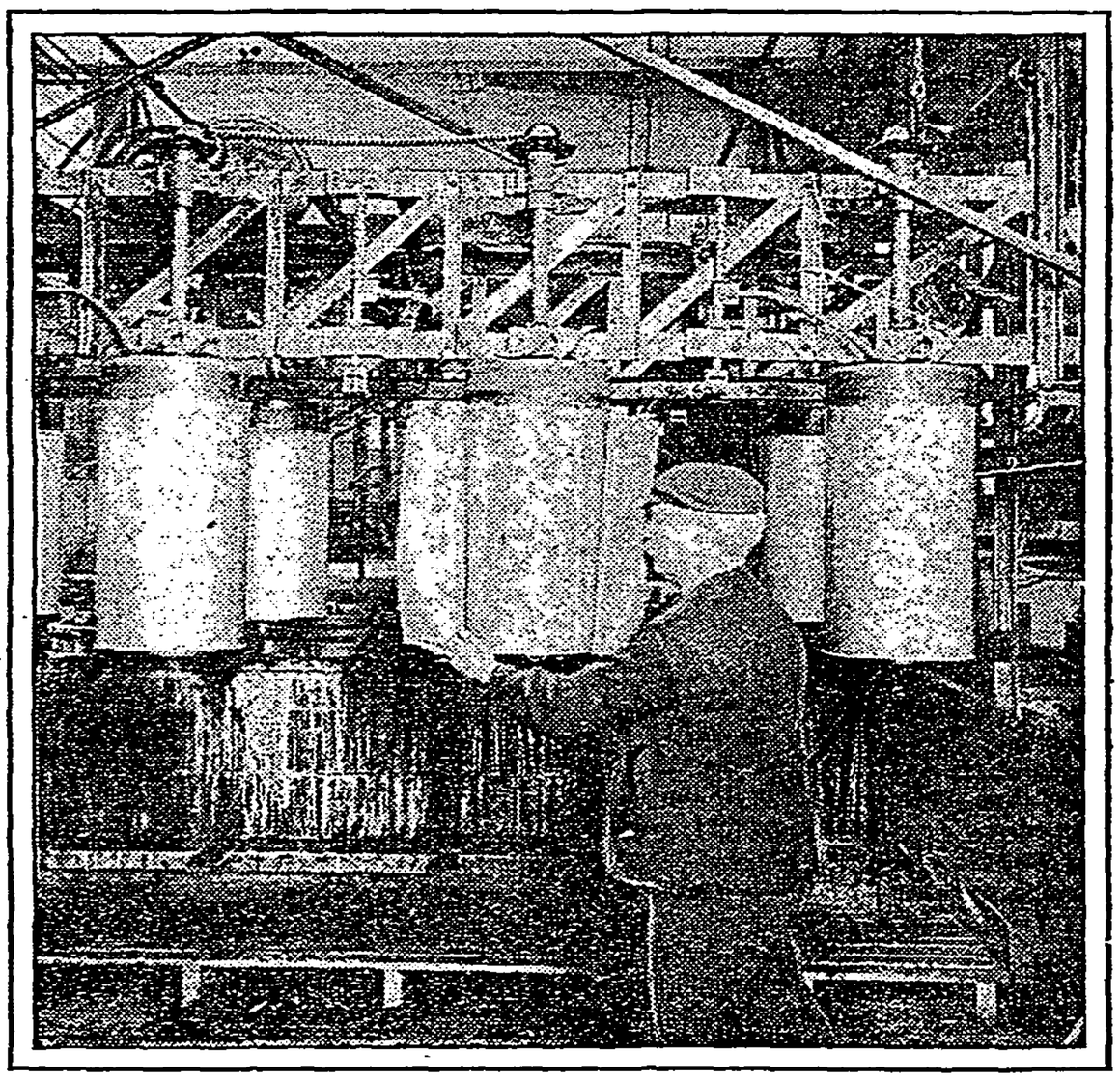
Of all fears which beset the submarine volunteer chlorine gas is the greatest. Five months after an inhalation of this deadly gas a cold may develop into pneumonia; the lungs seldom gain their previous healthy condition. If Mr. Edison's battery "comes up to scratch," as they say in the navy, it will solve those two great problems of life and power which, up to the present time, have made the submergible as dangerous in peace as in war, and as perilous to its crew as to its enemy. It will not only stimulate enlistment, but it will make American underwater craft the safest and most powerful fighting unit in the world.

Several weeks ago the electrical class of the Brooklyn Navy Yard visited Mr. Edison's plant. During their visit he gave them a talk on his new battery.

"Keep it clean, and give it water," said he, "and at the end of four years it will give its full capacity."

"Four years?" they asked in wonder.

"Yes," replied Mr. Edison, "Four years, eight years; it will outwear the submarine itself."



How the Flake Nickel for the Submarine Battery Is Peeled Off in Thin Strips.

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