A VISUAL GUIDE TO THE S-CLASS SUBMARINES 1918-1945 PART 1: THE PROTOTYPES

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BY

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Throughout the rich history of the United States Navy Submarine Service, there are several submarines that have become iconic and are among the first mentioned in history texts. The *Holland, Gato, Nautilus*, and *George Washington* always receive top billing when discussing submarine history and deservedly so. They were technological pathfinders or the parent of large and important classes that won wars or kept the peace. But, in the 1920's, an entire class of submarines achieved that iconic status and came to represent the Silent Service in the minds of the public.

Designed during WWI when German U-boats were running amuck in the Atlantic, the S-class of submarines were to be our Navy's first true ocean going attack submarines. All previous classes had been designed for harbor defense or coastal patrols and were not suited for blue water operations. The S-class, while not a true Fleet Boat as the Navy defined that term, were to be longer ranged, faster, more heavily armed, and more habitable than any previous submarine class. They wound up being too late to see action in WWI, but they began to enter the fleet just as the Roaring 20's started. The 51 submarines of this class comprised the largest single class of submarine in the U.S. Navy until WWII, and it made up the bulk of our Navy's submarine force during the 1920's and 30's. Some of the S-boats served right up to the end of WWII, an unheard of longevity for the time.

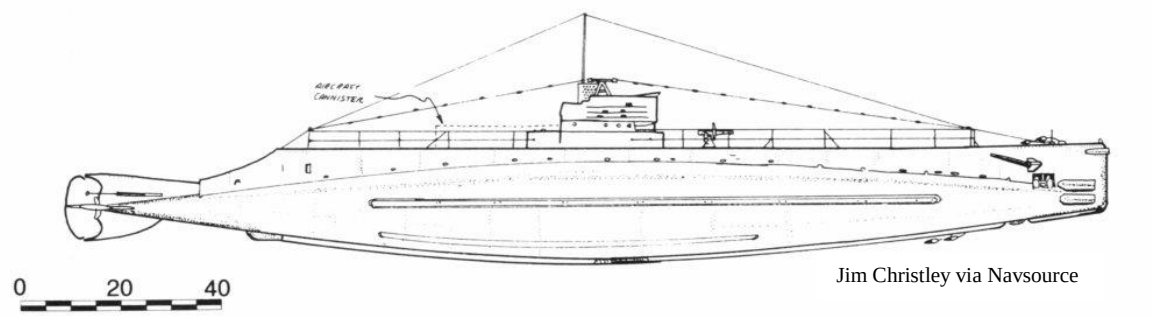
One of the accepted definitions of the word *class* is "a number of things regarded as forming a group by reason of common attributes, characteristics, or qualities." In the Navy, a class of warships will meet this definition, but in addition the ships will also look and be outfitted in such a manner as to be nearly identical. The layman might be surprised to learn that the 51 S-class submarines were anything but a homogenous, identical group and were in fact a class in name only. The S-class was actually made up of no less than six distinct groups that were built by four different manufacturers. The Navy considered all 51 boats a single class because they were all designed to meet the same set of performance and military specifications. These specifications were approximately 800-1000 tons submerged displacement, length approximately 250 ft., surface speed 18-20 knots, submerged speed 14 knots for 1 hour and 10 knots for 3 hr, surface range radius of 5000 nautical miles, and 4 bow torpedo tubes (two reloads each).

Up until about 1916, the Electric Boat Company of Groton, CT. (EB) had been the defacto design agent for U.S. submarines and enjoyed a near monopoly on construction.

Several factors, though, had begun to strain their relationship with the Navy. The incorporation of patented features that stunted competition, poorly performing engines built by one of their subsidiaries, and what many officers felt was undue use of political influence led to a feeling of ill-will towards the company. In order to reduce its dependence on EB, the Navy's Bureau of Construction and Repair wanted to have its own in-house design capability and thus designated the Portsmouth Naval Shipyard in Kittery, Maine as the Navy's lead submarine design entity. Congressional oversight committees also felt strongly that some level of commercial competition was needed. Thus, the Navy's General Board kept the design characteristics for the new submarines as general as possible, to give the various designers a free hand. Three prototypes were to be developed for the new 800 tonner, Portsmouth and EB submitted their designs, with a third coming from the Lake Torpedo Boat Company of Bridgeport, CT.

ELECTRIC BOAT

Electric Boat's model became the USS *S-1* (SS-105). This design is sometimes referred to as the "Holland" S-boat, a reference to EB's founder John Holland.



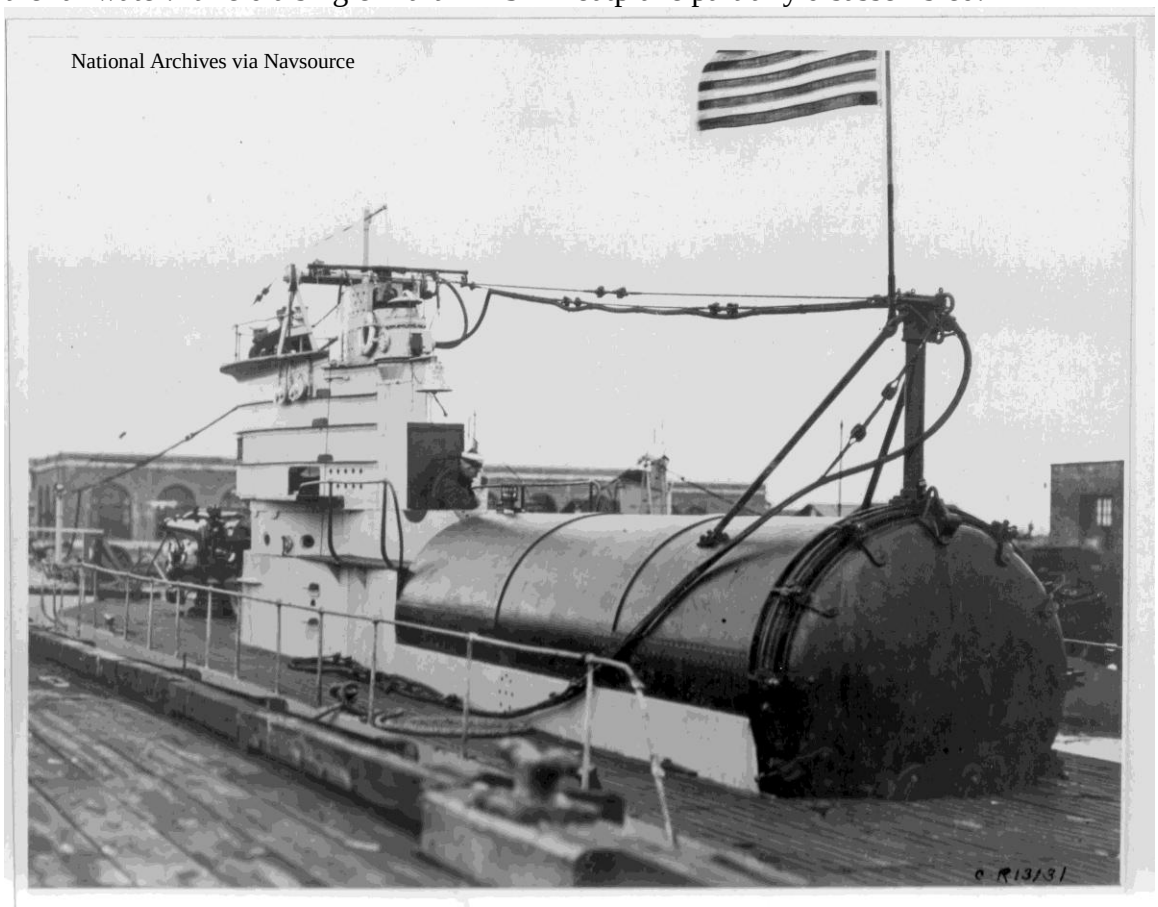
Jim Christley via Navsource

It was a single hull design, with all ballast tanks internal to the pressure hull. The hull was a rounded spindle shape with a narrow superstructure atop it that ran ¾ of the way to the stern before the skeg tapered sharply down to the rudder. The rudder itself was placed at the very end of the hull, in line with the hull's axis and aft of the twin screws. She had four 21-inch torpedo tubes forward, a prominent towing fairlead pipe at the far forward, upper end of the superstructure, and a single starboard side anchor. A squared off conning

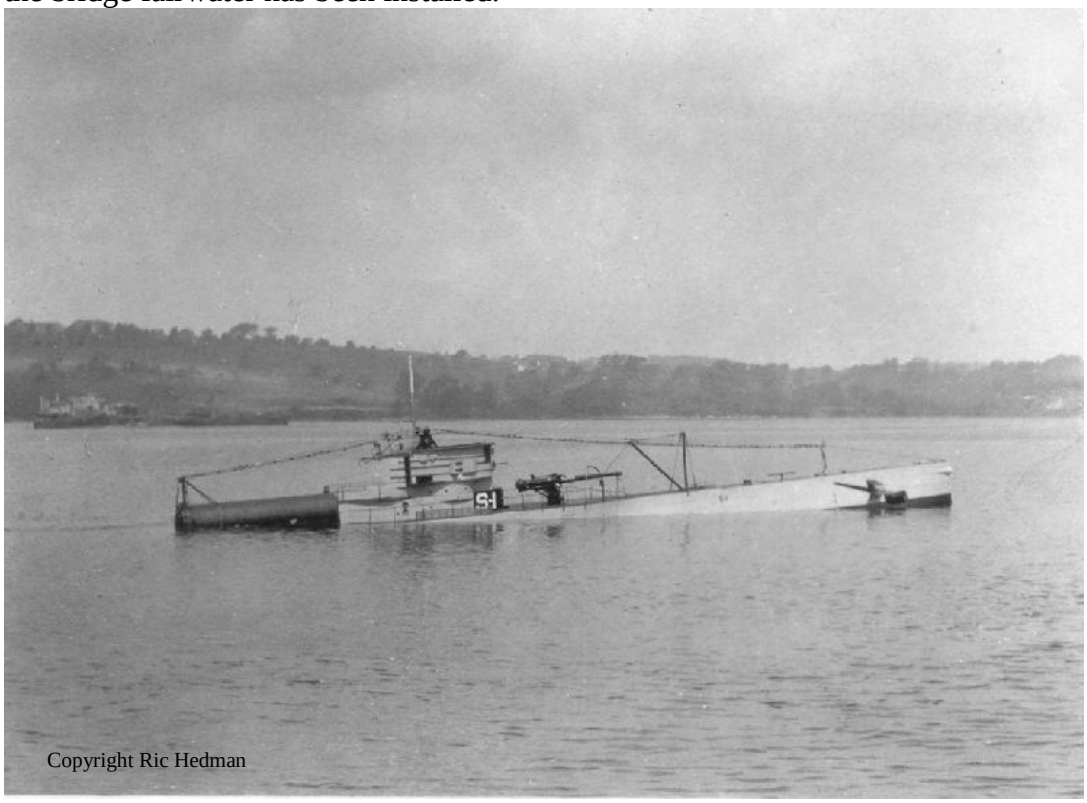
Photo # NH 99772 USS S-1 underway during trials, circa April 1920

USNHC photo via Navsource

tower fairwater sat dead center on the superstructure, supporting the periscopes and radio aerials. As built, she sported a small 3-inch/23 caliber Mk 9 deck gun that partially retracted, breech end first, into a watertight tub that penetrated the superstructure forward of the fairwater and into the pressure hull over the forward battery. A circular gun shield attached to the barrel formed the watertight top of the tub. A desire to reduce drag and thereby increase underwater speed led to the adoption of this unusual gun. Lessons from German experience with larger guns were still forthcoming. Her bow planes retracted aft into the superstructure, one of the earliest examples of this feature. She was, in effect, an enlarged version of the earlier EB R-class boats. EB did not at this time have the large construction yard in Groton and thus contracted the *S-1*'s construction to the Fore River Shipbuilding Co. of Quincy, Massachusetts. The photo above shows her on her trial runs, with a portion of the conning tower fairwater surrounding the bridge not installed, a common construction technique of the time. Note also the angular fairwaters for the bow plane pivots on the forward superstructure. This feature was repeated on some, but not all of the later EB S-boats. Overall, the *S-1* had even, well-proportioned lines. This was mostly due to the fact that alone among the three prototypes, EB split the boat's main battery into two halves, with half forward of the control room, and half immediately aft. This was a favored feature of EB designs, which added a level of mechanical redundancy. A fairly successful boat, the *S-1* was chosen in 1926 to conduct the Navy's first (and as it turned out, only) tests in carrying and launching an airplane from a submarine. For these experiments, she was fitted with a small, horizontally mounted cylindrical hanger aft of the fairwater. It held a single Martin MS-1 floatplane partially disassembled.

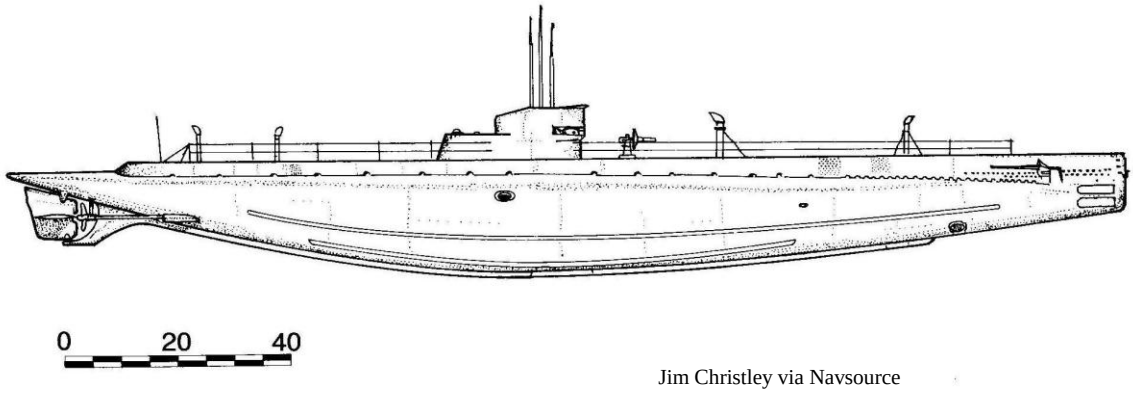


She was also refitted with a larger, more powerful 4-inch/50 caliber deck gun (coincidentally also designated Mk 9), necessitating the widening of the deck around the gun. This gun replaced the 3-inch/23 caliber disappearing mount that was roundly disliked by the crew as being unreliable and lacking punch. Notice also in this picture that the bridge fairwater has been installed.



LAKE TORPEDO BOAT CO.

The brilliant but eccentric Simon Lake and his Lake Torpedo Boat Company were EB's only real competition in the years leading up to the S-boats. They were chosen to submit a design that became the USS *S-2* (SS-106). Being a modified double hull design it was generally cylindrical in shape, but it tapered sharply upward forward and aft, giving the amidships portion a somewhat squat, almost pregnant look. The stern was a flat, horizontal "shovel" shape, a Lake trademark. Her rudder was mounted beneath the stern (as opposed to EB's axial mounted rudder), whose pivot structure also supported the stern



Jim Christley via Navsource

planes. The superstructure ended short of the stern. She also had a starboard side anchor and fully retractable bow planes. Her battery was situated forward of the control room, and that the visual effect of pushing the conning tower fairwater aft a little. Like the *S-1*, she conducted her initial sea trials without the bridge fairwater installed.

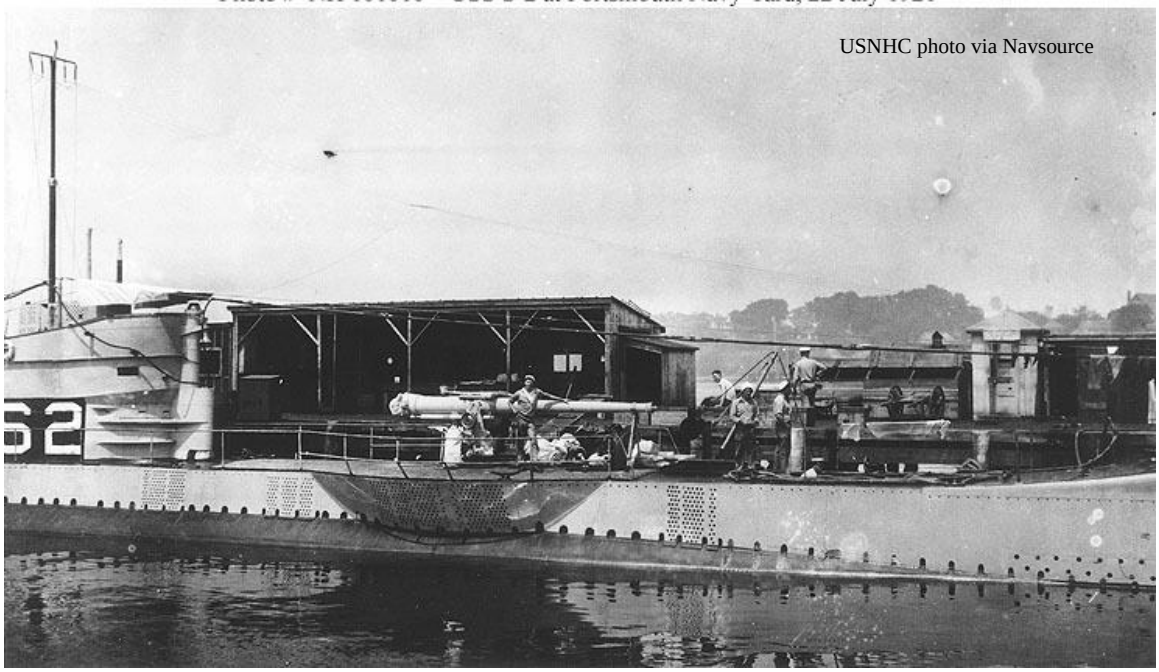
Photo # NH 41992 USS S-2 underway, probably during trials in 1919

USNHC photo via Navsource

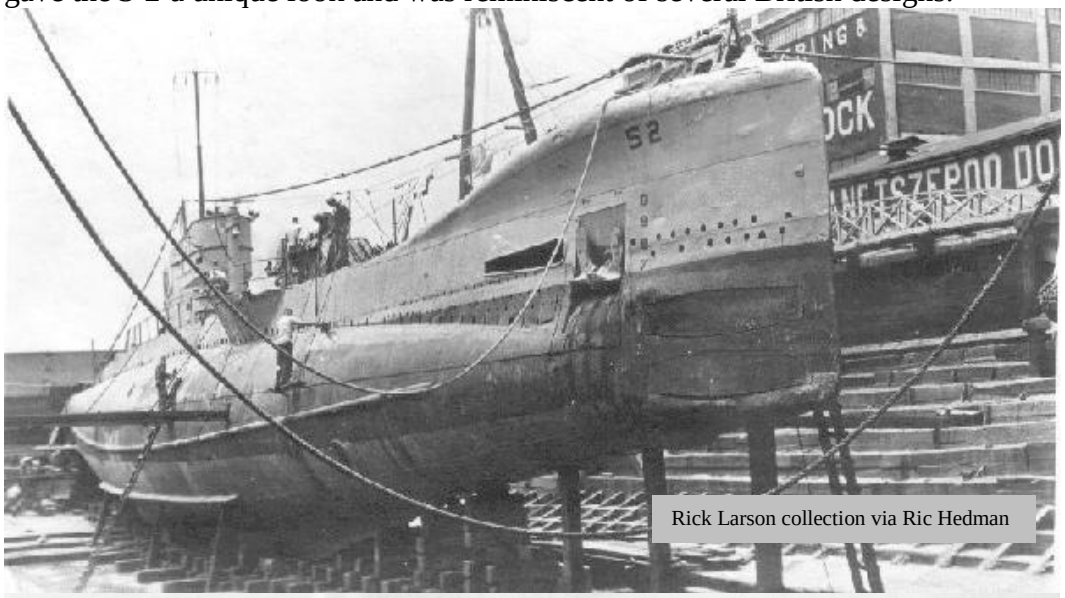
Initially built without a gun, she was also refitted with a 4-inch/50 caliber Mk 9 weapon. Similar to *S-1*, her deck around the gun mount had to be expanded outward to provide adequate space for the large gun, in this case a considerable amount. A portion of her

Photo # NH 101010 USS S-2 at Portsmouth Navy Yard, 22 July 1921

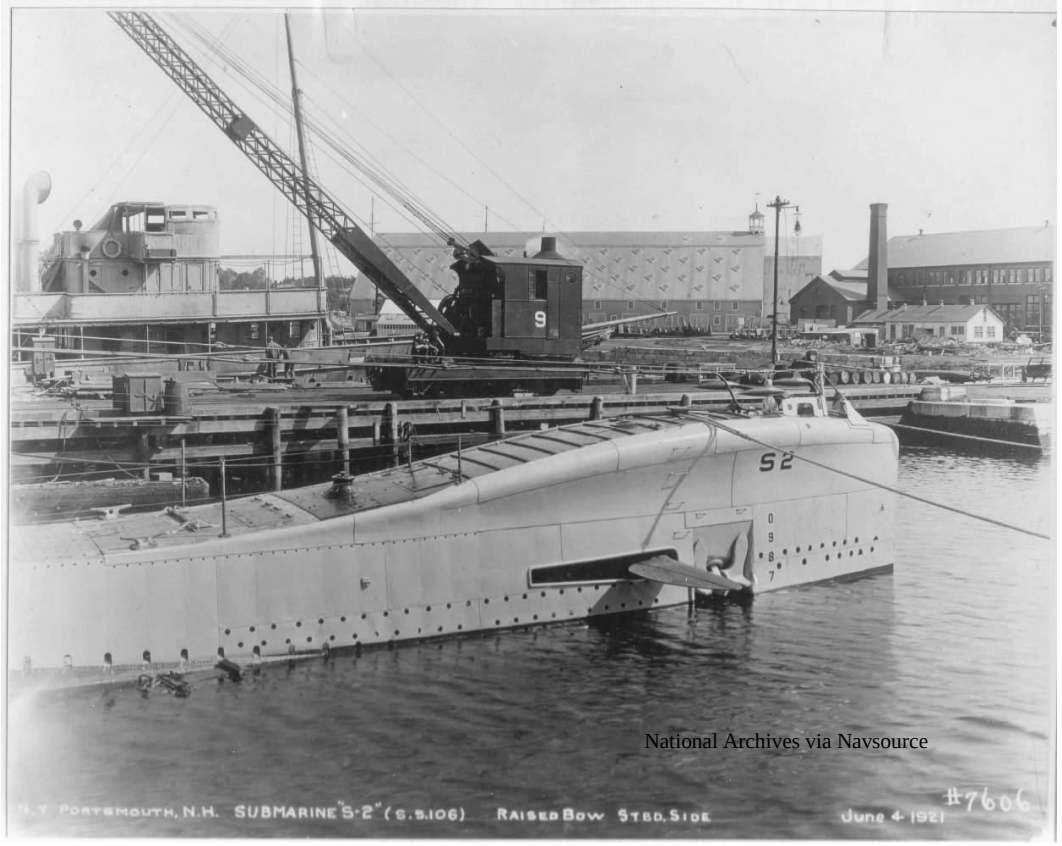
USNHC photo via Navsource



superstructure amidships was designed to be watertight while surfaced. This was to provide much needed reserve buoyancy while surfaced, but unfortunately the added buoyancy was actually needed in the bow. A thorough series of sea trials after her commissioning revealed that she tended to burrow into the waves while surfaced, making for a very wet deck and bridge. Accordingly, Simon Lake designed a fix for this problem that resulted in the addition of a bow buoyancy tank external to the superstructure. This gave the *S-2* a unique look and was reminiscent of several British designs.



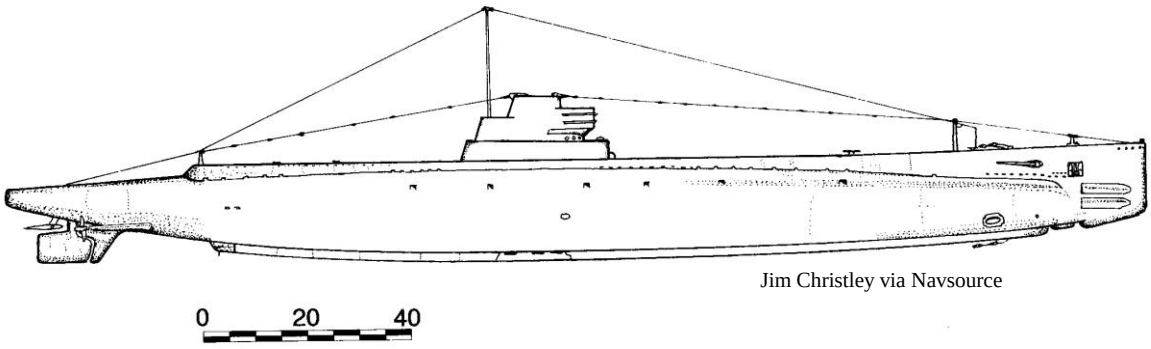
Rick Larson collection via Ric Hedman



National Archives via Navsource

PORTSMOUTH NAVAL SHIPYARD

The Government's design for the S-boats (sometimes called the "Bureau" design, after the Bureau of Construction & Repair) was built at Portsmouth Naval Shipyard and eventually commissioned as the USS *S-3* (SS-107).

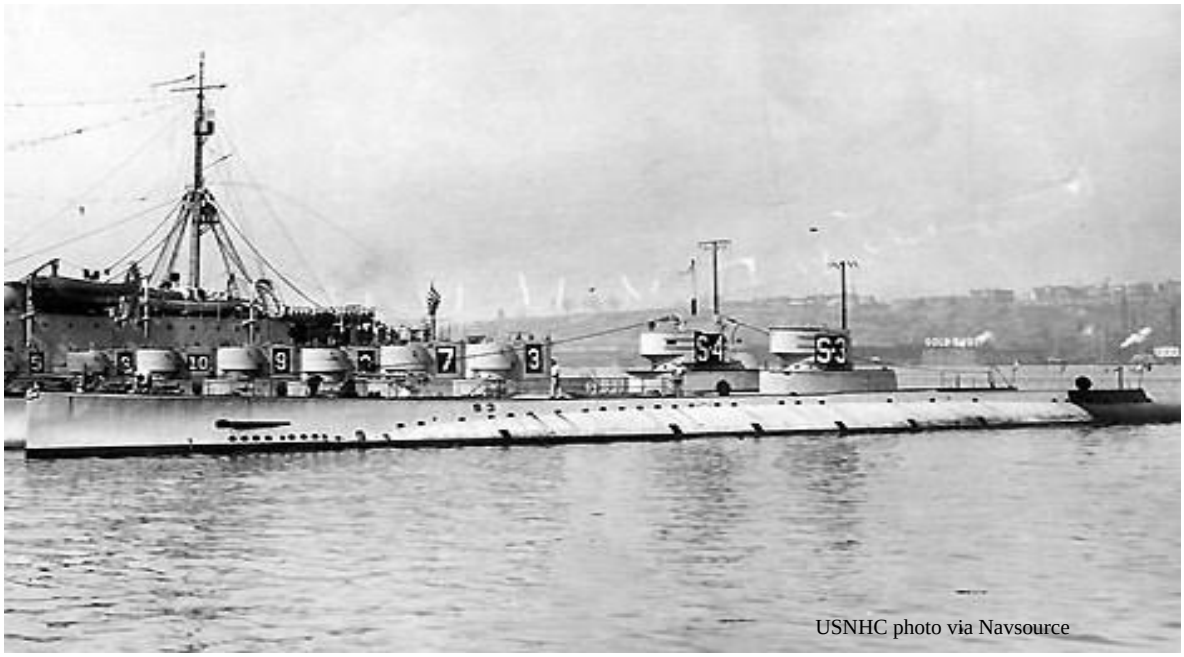


Jim Christley via Navsource

A full double hull boat, all of her main ballast tanks were contained exterior to the pressure hull. She was considerably longer (231 ft. vs. 207 ft. for *S-2* and 219 ft. for *S-1*) and a little wider than the other two boats, giving her a long, sleek appearance. Although a unique design by Portsmouth, *S-3* incorporated several Lake patents, which the chronically underfunded Lake allowed (for a nominal fee of course) thinking it would help him financially. Similar to *S-2*, her battery was contained in one large compartment forward of the control room, which had the visual effect of pushing her conning tower fairwater well astern. Despite this, some believe that the Government design was the most visually striking of the three, with graceful lines that are more appealing than the boxy, squared off look of the EB design. The long hull had far less curve to it than the *S-1* or *S-2* and the stern ended in a sharp vertical "chisel". The rudder was underneath the stern (one of the Lake patents), but the stern planes were suspended on their own support post above the rudder.

National Archives via Navsource

The distinctive, stepped bridge fairwater bulged far forward and hung over a prominent ready-use ammunition locker. The deadlights for the conning tower itself were easily visible directly between these two structures. The superstructure was quite narrow and ended far short of the stern. The periscope support shears for *S-3*'s two control room devices initially did not extend above the rest of the conning tower fairwater, as evidenced in the photo below (compare to her sister *S-4* sitting alongside). The shears were eventually lengthened to match her sisters in a subsequent overhaul. A short, 10 ½ foot third periscope was installed in the conning tower.



USNHC photo via Navsource

Also built without a deck gun, *S-3* had a 4-inch/50 caliber Mk 9 gun added later, and this necessitated the widening of the deck forward of the conning tower. Like the other two prototypes, she had a starboard side anchor and fully retractable bow planes, but did not have the prominent towing fairlead pipe at the bow like the *S-1*.

CONCLUSION

Simon Lake's *S-2* had her share of problems and was not well liked by her crews. An inveterate tinkerer, the perfectionist Lake constantly modified the boat and thus he could not offer the Navy a "finished" design suitable for mass production. Lake's ideas, although sound in nature, were often proved less than optimal in practice. She was a slow diver due to her partially watertight superstructure and poorly designed flooding and venting mechanisms for the main ballast tanks. Her flat top internal tanks (as opposed to EB's patented U-shaped tanks) required more bracing and greatly reduced internal available space, making her a very cramped boat. The piping arrangement leading to the ballast tanks was overly complicated and her forward and aft trim tanks were so large that they were prone to develop a free surface effect, which adversely affected underwater control. This was Lake's last internal design to be accepted by the Navy. No contract for

any further boats of this type was awarded to Lake, although he did build S-boats of the Government type under license (See part two of this series).

Although ultimately proven to be flawed in many areas, both the *S-1* and the *S-3* designs were deemed satisfactory enough to warrant series production. The *S-1* had better underwater maneuverability, was a fairly fast diver, and her single hull construction eased exterior maintenance. The *S-3* had better engines and a longer range. In the end, the Navy felt that both types were nearly evenly matched, but EB ended up with the bulk of the construction, mostly due to the much larger construction capacity they enjoyed with her contractors Union Iron Works and Fore River Shipbuilding Co.

ACKNOWLEDGEMENTS

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