A VISUAL GUIDE TO THE S-CLASS SUBMARINES
1918-1945
PART 3: THE ELECTRIC BOAT GROUPS

(3rd Edition, February 2023)

BY

DAVID L. JOHNSTON

The Electric Boat Company (EB) of Groton, CT. won the majority of the construction contracts for the S-boats. Not that their product was necessarily superior to the Government or Lake designs, it was that EB had a much greater construction capacity and simply had the capability to build more boats faster. Oddly, EB themselves had never built a submarine before. Construction of all of the company's products had been contracted out to other firms, mostly the Fore River Shipbuilding Company of Quincy, MA. and Union Iron Works of San Francisco, CA. Both companies had been bought out by Bethlehem Steel and by the time of S-class construction they were known as Bethlehem Quincy and Bethlehem San Francisco. EB's Groton facilities consisted only of their New London Ship & Engine Company (NELSECO) engine subsidiary. They would not have a shipbuilding yard there until 1924, too late to build any of their S-boats.

ORIGINAL CONFIGURATION

S-18 through *S-29* would be the first group and were built at Quincy. They were straight forward follow-ons of the *S-1* single hull design with just minor differences. Figure 1 shows *S-25* in drydock in the boat's as-built configuration. The towing fairlead pipe through the upper edge of the bow (a unique feature of the EB design), the starboard side anchor, and the angular cover for the bow plane pivots are all clearly visible. The bow planes retracted into the hull at an upward angle. Note the three "rats" for the Y-tube sound gear on the top of the forward deck, and secondary MV series hydrophones in a long housing on each side of the bow below the waterline. Just forward of the MV arrays the boat's mushroom anchor can be seen. This anchor was used to moor the boat while submerged near shore, while awaiting an enemy ship to pass. It could be operated from

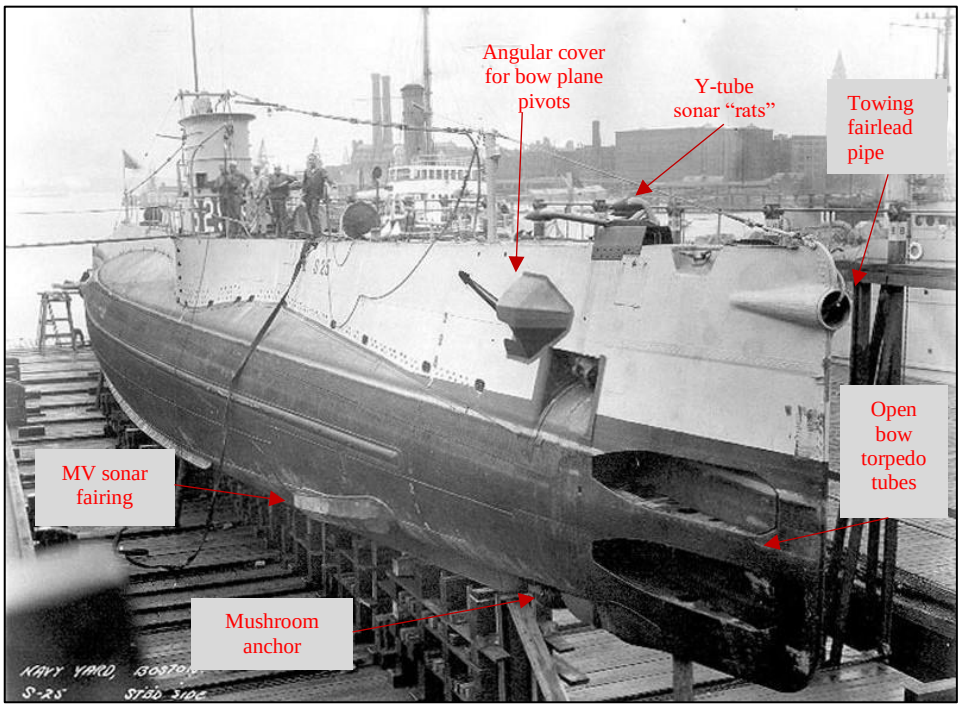

Fig. 1. S-25 on the marine railway at the Boston Navy Yard, 22 Oct 1923. Boston Navy Yard photo #7158 via Navsource.

inside the boat. This was a little used concept. Figure 2 gives an excellent starboard side perspective of *S-25.* The short extension of the conning tower fairwater just forward of the bridge and directly above the

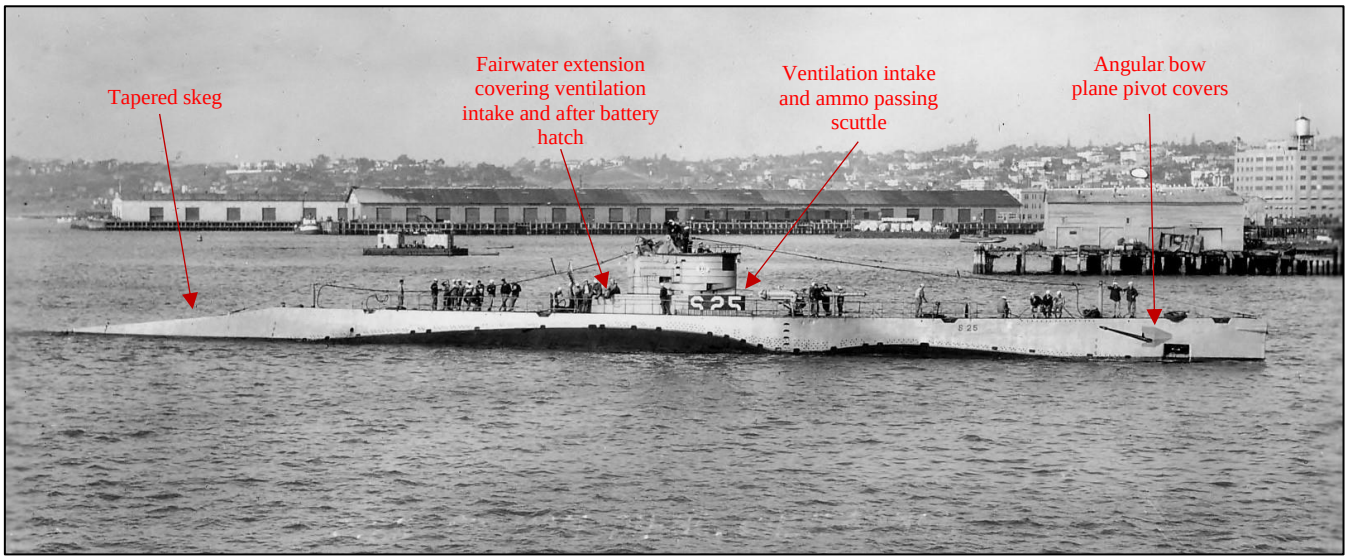

Fig. 2. S-25 pulling into Naval Station San Diego, approximately 1924. USN photo via Navsource.

number 5 was a cover for a ventilation intake and an ammunition passing scuttle for the deck gun. The aft extension of the conning tower fairwater covered an access hatch to the after battery compartment and a ventilation intake. This aft extension was found to be too low; it allowed too much water to ship the hatch

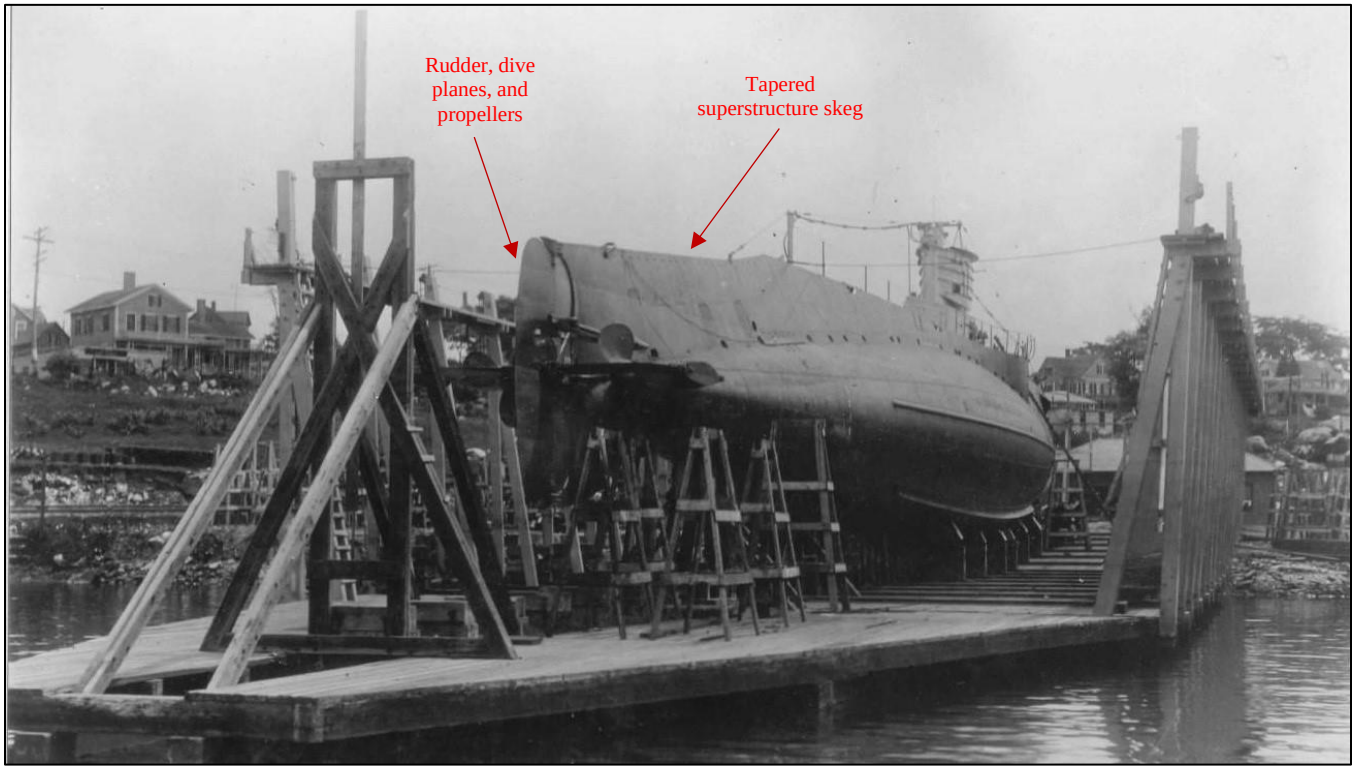

Fig.3. S-25 on the marine railway at the Submarine Base in Groton, CT., 05 July 1923. NARA photo 19-N-10271 via Navsource.

and intake. It was later raised on all of the EB design boats that had it. Figure 3 shows *S-25* high and dry on the marine railway at the Submarine Base in Groton, CT. It shows the distinctive axial mounted rudder and the original configuration of the superstructure "skeg" which ran from the end of the deck and tapered gently down to the rudder. This skeg would prove to be prone to damage from salt-water corrosion. It was

later removed during the safety upgrades. When compared to Figure 2, it can be seen how the rudder, screws, and diving planes were out of view underwater when the boat was surfaced.

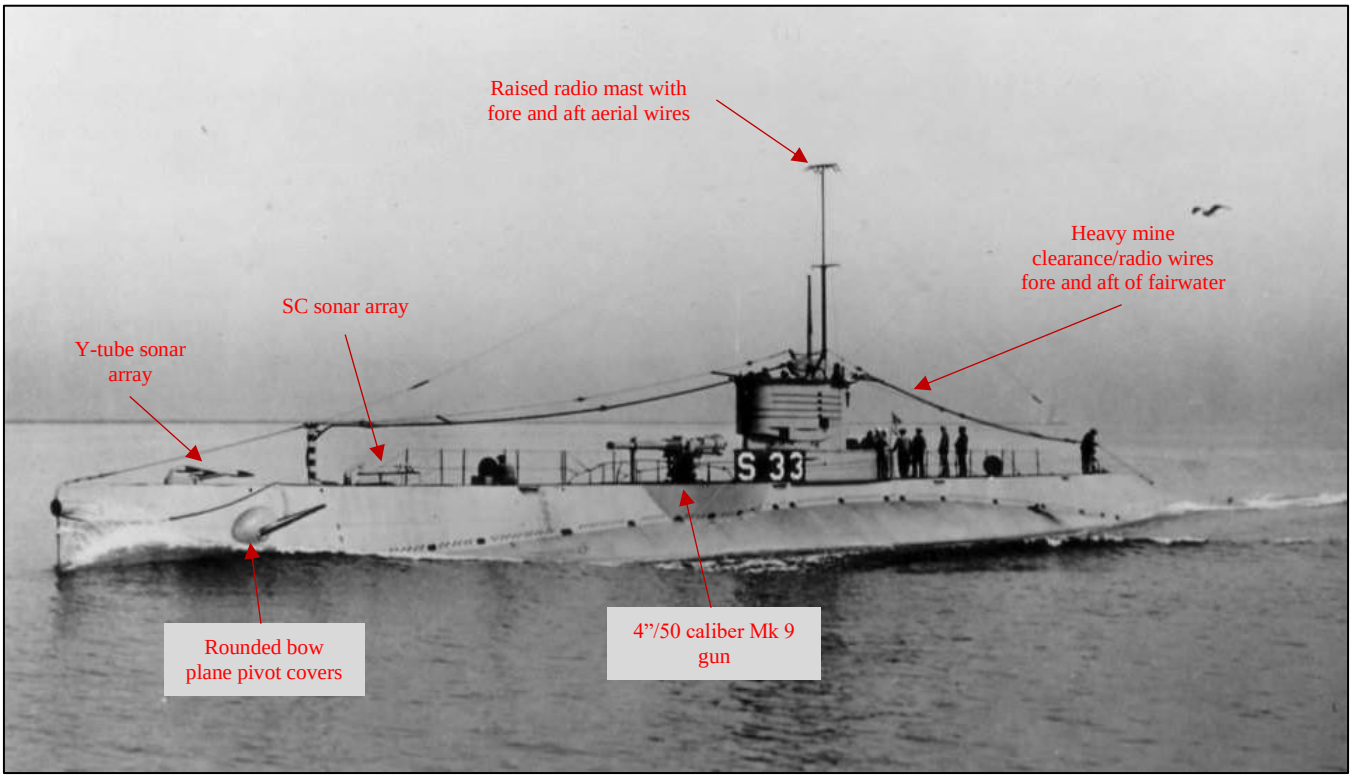

Fig. 4. S-33 on builder's trials near San Francisco on 04 November 1920. Severe engine problems would prevent her from being accepted by the Navy for another 18 months. NARA photo 19-N-6120 via Navsource.

The second group consisted of *S-30* through *S-41* and these boats were built by Bethlehem San Francisco. They were virtual duplicates of the 20 series boats. The only noticeable difference between the groups was the different shape of the housing for the bow plane pivots. The Quincy built 20 series had a prominent angular, slab-sided cover, while the San Francisco built 30 series had a smaller, rounded cover.

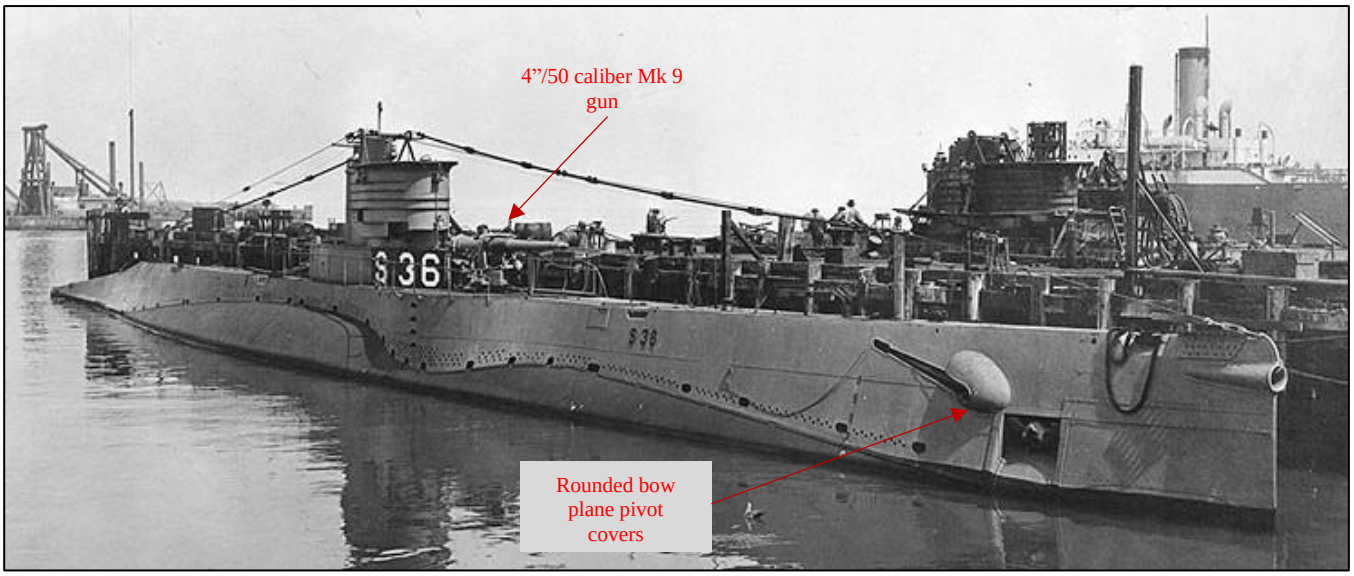

Fig. 5. S-36 alongside at the Bethlehem San Francisco yard, 29 March 1923. USN photo NH-51827 via Navsource.

This may indicate a change in bow plane operating mechanisms for the 30 series. Figures 4 and 5 of *S-33* and *S-36* give good views of the as-built configuration of this group. Note that all of the 20, 30, and 40

series EB design boats were built with the expanded gun sponson and the larger 4”/50 caliber Mk 9 deck gun. The smaller 3”/23 caliber “disappearing” gun originally installed on the *S-1* was quickly removed. It was lacking in power and was unreliable. *S-33* displays a hybrid sonar outfit at this early stage, with both the Y-tube and SC sonar arrays on the forward deck. Long range radio communications in this period required a very long antenna array, and the wires for this can be seen on *S-33* attached to the bow, running up to the raised radio mast, then down again to the stern. A heavier, secondary array which doubled as a mine clearance wire can be seen on *S-36* attached to a short mast on the forward deck, running up to a triangular stanchion just aft of the bridge, and then down to another short mast on the aft deck. Note also that both of these boats were completed with the bridge fairwater installed, unlike *S-1* which ran trials without it.

As stated previously, after a few years of operation the after battery hatch trunk and the aft ventilation intake were raised along with the aft conning tower fairwater extension in order to keep this part of the boat drier in heavy seas. All of the 20 and 30 series boats received this modification, and it is shown in Figure 6 on the *S-39*. This photo also shows good details of the conning tower fairwater and the deck gun. The radio mast is fully raised, and at the top can be seen two masthead lights, a safety improvement retrofitted after the *S-51* accident in 1925.

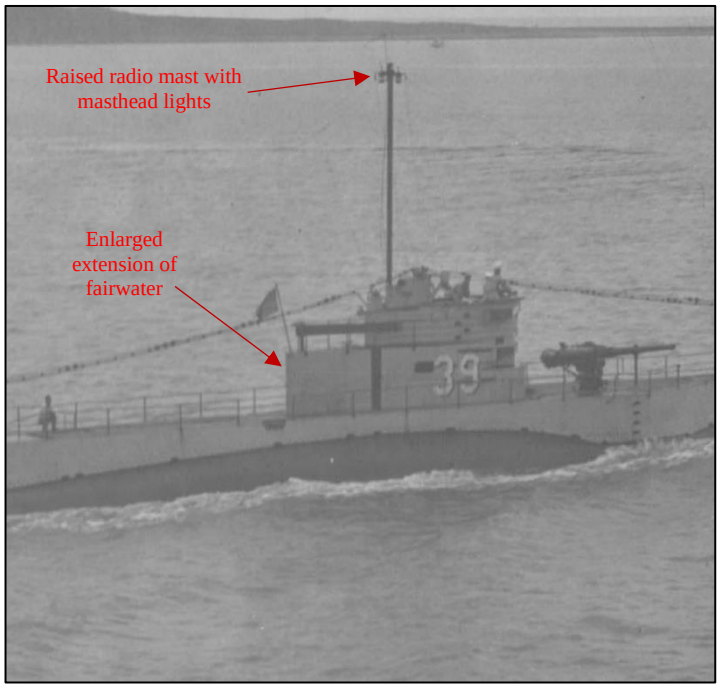

Fig. 6. S-39 shown underway off Tsingtao, China on 13 June 1930. NARA photo 80-G-466176 via Navsource.

Group three of the EB boats consisted of *S-42* through *47*, all built at Quincy. The EB designers tinkered with the design somewhat and these boats were built with several important and distinctive modifications. Figures 7 and 8 of the *S-45* are representative of this group.

Lengthened by six feet and weighing in approximately 33 tons heavier, these boats had a rearranged ballast and fuel tank arrangement and had modifications to their duct keel and Kingston valve installations in an attempt to make them faster divers. Note that these boats had a slightly modified but

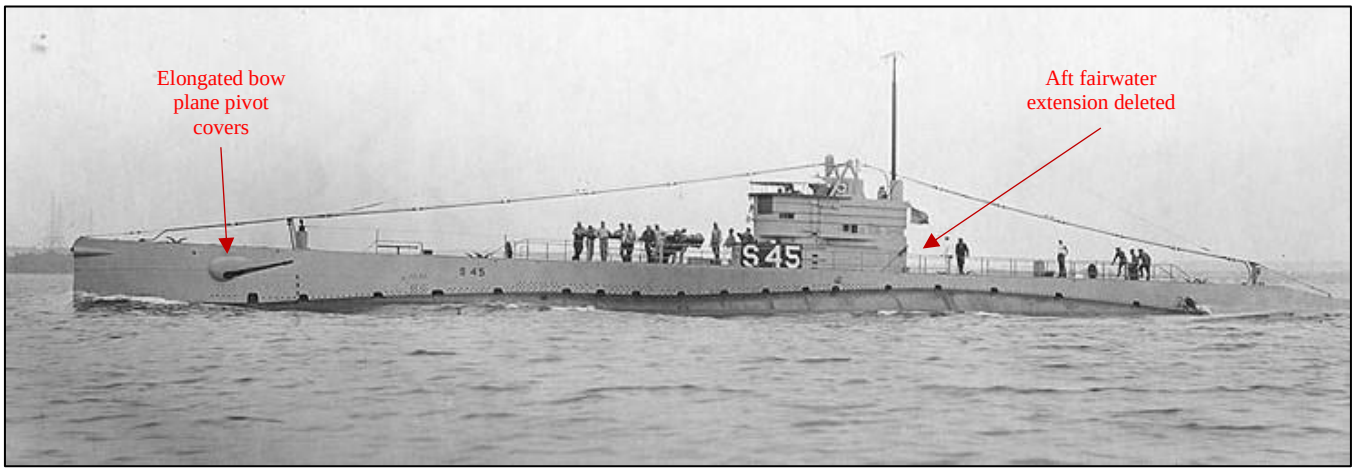

Fig. 7. S-45 underway shortly after commissioning, 1925. USN photo NH-1373 via Navsource.

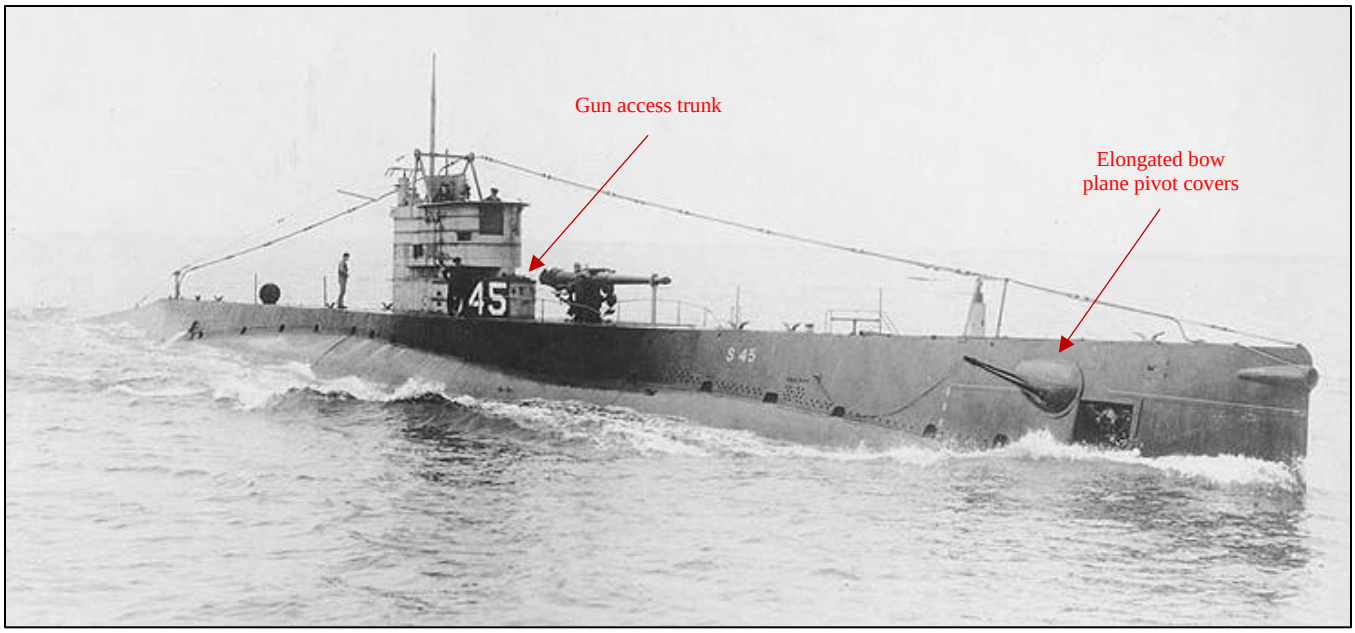

Fig. 8. S-45 on trials in Long Island Sound, 24 March 1925. USN photo NH-42186 via Navsource.

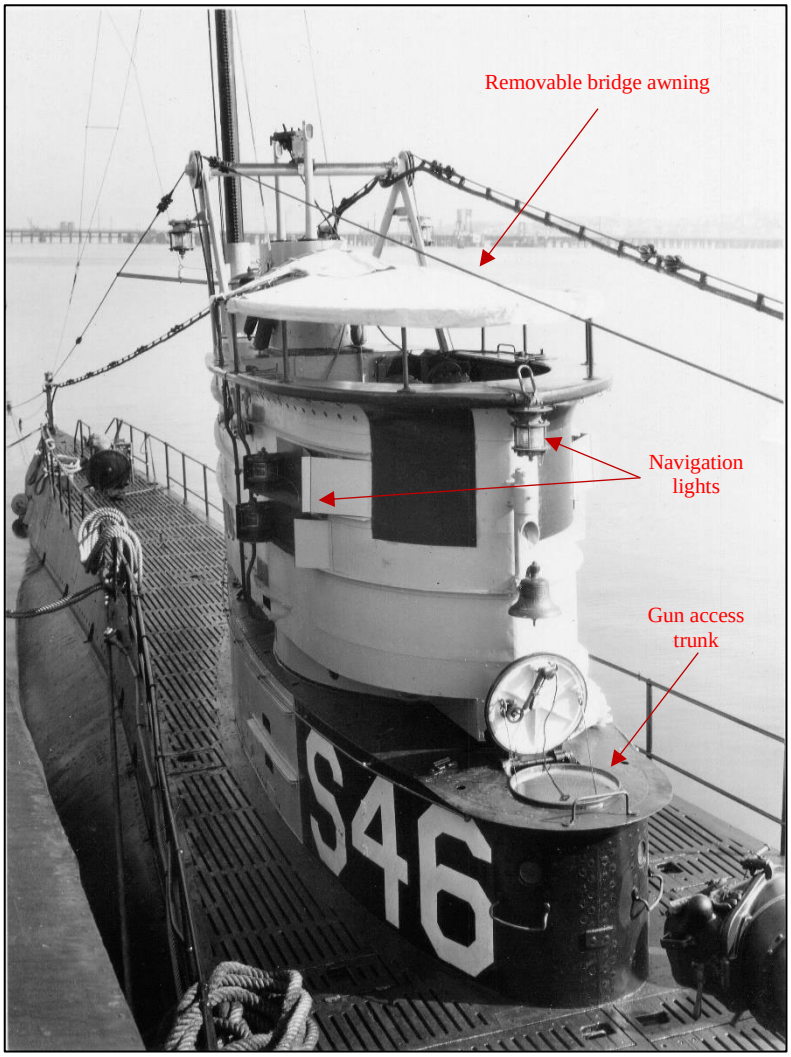

Fig. 9. A closeup view of S-46's conning tower fairwater while alongside at the Mare Island Navy Yard, late 1920s. USN photo NH-72134 via Darryl Baker and Navsource.

distinctive elongated version of the rounded bow plane pivot covers of the 30 series. Taking advantage of the extra length in the middle of the boat, a full gun access trunk was installed at the forward edge of the conning tower fairwater, replacing the smaller ammo-passing scuttle on the earlier boats. Figure 9 is a good view of *S-46* and her fairwater. This hatch allowed quick crew access to the deck gun directly from the control room. The previous boats had a hatch aft of the conning tower, hidden by an extension of the fairwater. This group lacked that aft extension and the hatch, but the ventilation intake remained, moved a little forward and closer to the periscopes. The *S-46* photo also gives good details of a temporary canvas awning that could be rigged above the bridge, the starboard swing out navigation lights, the bridge mounted navigation light and the boat's bell. In an emergency, the gun access trunk could also be used as an escape trunk.

SAFETY MODIFICATIONS

The multiple sinking disasters of the *S-5, S-48, S-51,* and the *S-4* and the inability of the Navy to rescue crewmen trapped inside a sunken boat prompted a thorough review of the safety features onboard our submarines. The EB design for the S-class was found seriously wanting in this regard. A list of desired modifications was drawn up based on this review and the Secretary of the Navy ordered all S-boats be modified no later than June, 1932. These modifications included strengthened internal bulkheads, Momsen Lung escape device installations, salvage air lines to each main ballast tank, air supply valves installed in each compartment, and an air bubble holding skirt installed on the torpedo room hatch inside the torpedo room (this enabled an escape from the room without completely flooding it). The torpedo room hatch also received an expanded seating area around it to enable a McCann Rescue Chamber (see Part 1 of this series) to attach to the hatch, with a marker/messenger buoy mounted nearby. A new escape hatch with a McCann chamber seating surface was added in the motor room and this required the cutting away of the superstructure skeg that ran from the aft deck down to the rudder. Just forward of this hatch a marker/messenger buoy with a telephone inside was installed. The cutting away of the aft skeg resulted in a dramatic change in the visual look of the boats, giving the impression of shortening the boats quite a bit. This was an illusion however, as the remainder of the pressure hull and the rudder were out of sight underwater. The original long skeg had actually given these boats a bit of trouble, as its interior was difficult to access for maintenance. On several of the boats the interior bracing of the skeg had rusted so badly it broke loose and fell off at sea, thus its removal for the safety modifications was rather fortuitous.

With the boat at normal surface trim, you could not see the aft escape hatch itself, as it was attached directly to the pressure hull between the messenger buoy and the rudder in an area that remained underwater while on the surface. Figure 10 shows *S-47, S-32,* and *S-26* moored outboard of the big fleet boat *Argonaut* at Honolulu Harbor in 1936. It shows how low the stern light sat (which was mounted on the rudder, unseen below the surface), making it very hard to see in anything except glass calm waters. The removal of the skeg and the addition of the messenger buoys were the only externally visible parts of the safety modifications. Notice the extra length of the *S-47* (the outboard boat) and the slightly different configuration of her messenger buoy as compared to the *S-32* (middle) and the *S-26* (inboard).

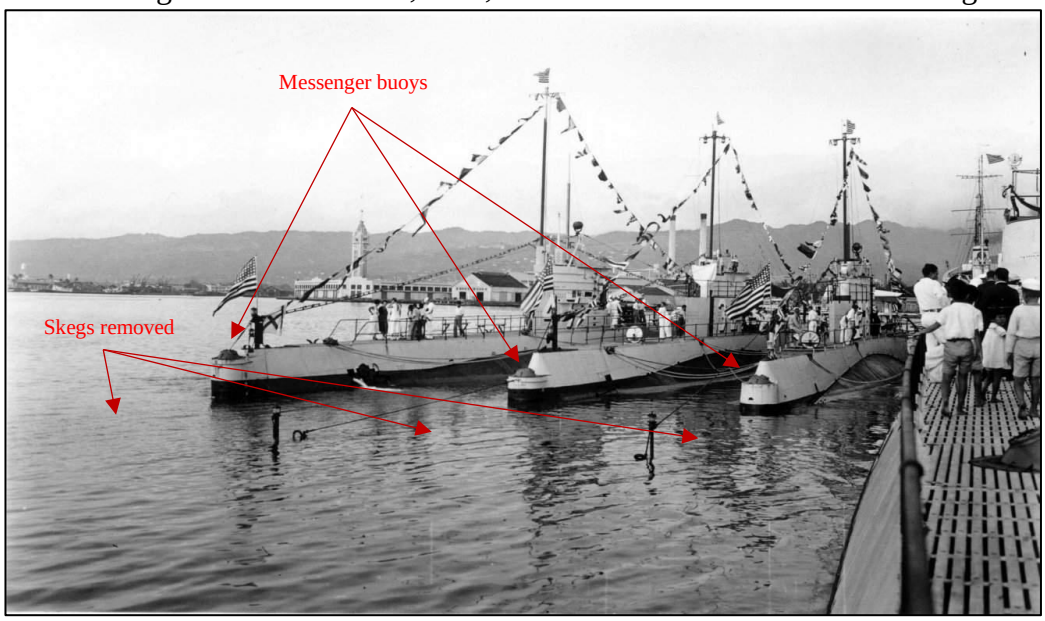

Fig. 10. Three S-boats alongside the big fleet boat Argonaut in Honolulu Harbor, 1936. USN photo via Navsource.

Figure 11 is an excellent 1935 shot of *S-39* underway in Subic Bay, Philippines, showing off the "stubby" look of the EB design boats after the removal of the skeg and the incorporation of the safety

Fig. 11. Post-safety modification picture of S-39 underway in Subic Bay, 1935. USN photo NH-51828 via Navsource.

modifications. On the far left the messenger buoy is just visible in its housing. The rest of the stern back to the rudders and propellers is underwater and out of view. Visible on her forward deck is a modification of the T-shaped SC sonar array, incorporating the ball-shaped JK sonar head on top of the SC.

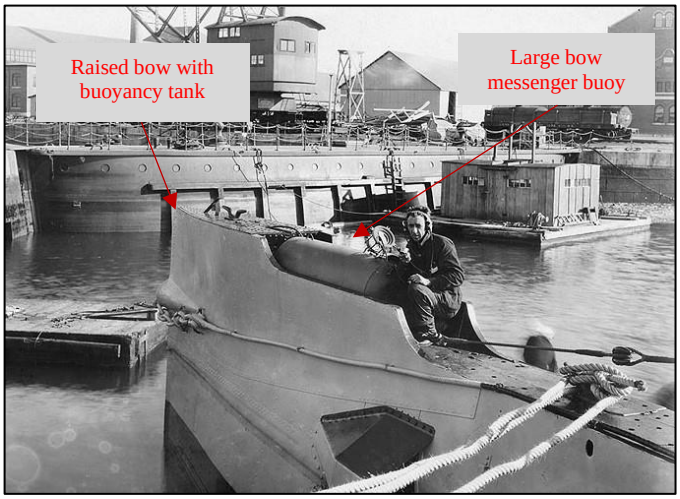

Fig. 12. S-22 at the Portsmouth Navy Yard, 21 November 1929. USN photo NH-42091 via Navsource.

Fig. 13. Closeup of S-22's escape hatch, 21 November 1922. Photo from Univ. of New Hampshire, Milne Special Collection, via PigBoats.COM.

S-22 was taken in hand and made a test boat for extensive (and as it turned out, unique) safety modifications. These included a buoyancy tank and a large telephone/marker buoy in the bow (Figure 12), a large escape trunk in the torpedo room which protruded above the main deck (Figure 13), an aft messenger buoy, and an aft escape hatch with a bubble skirt in the motor room. She also got all of the internal changes made to the other EB boats. Curiously, in this initial configuration, the forward escape trunk shown in Figure 13 did not have a seating surface for a McCann chamber, leaving only the motor room escape hatch aft with McCann capability.

Her aft escape hatch is just visible on the right in Figure 14. It sat right at the waterline and would not have been used for routine access to the boat. Note also the unique configuration and placement of the aft messenger buoy. This photo also shows temporary lifting pad eyes attached to the upper edges of the pressure hull. These were used for lifting experiments while alongside the pier and were not intended for

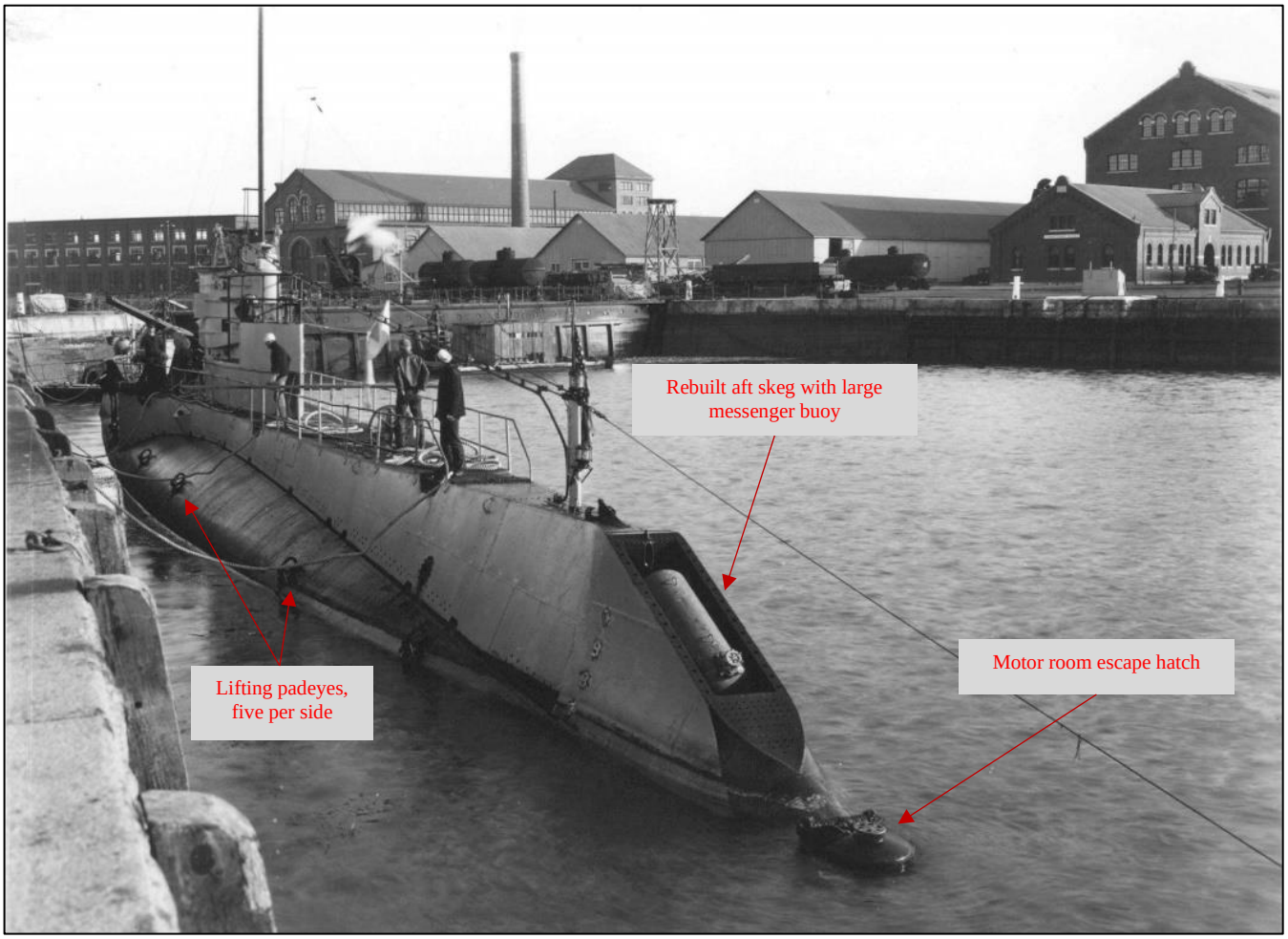

Fig. 14. Portsmouth Navy Yard, 21 November 1929. Stern perspective of the unique safety modifications made to S-22. Note how low the motor room escape hatch is, unusable for routine access. Photo from the Univ. of New Hampshire, Milne Special Collection via PigBoats.COM.

operational use. They were later removed. These unique modifications were not carried out on other S-boats, although the large escape trunk was incorporated into the later fleet boats. The large messenger buoys were later removed and replaced with smaller ones that complied with the standard set for other boats. The forward escape trunk was retained, and a McCann seating surface was later added. Figure 15 shows a black painted *S-22* at a gunnery practice exercise sometime in 1938 or 1939. It shows the replacement of the forward messenger buoy and the addition of the seating surface on the forward escape trunk.

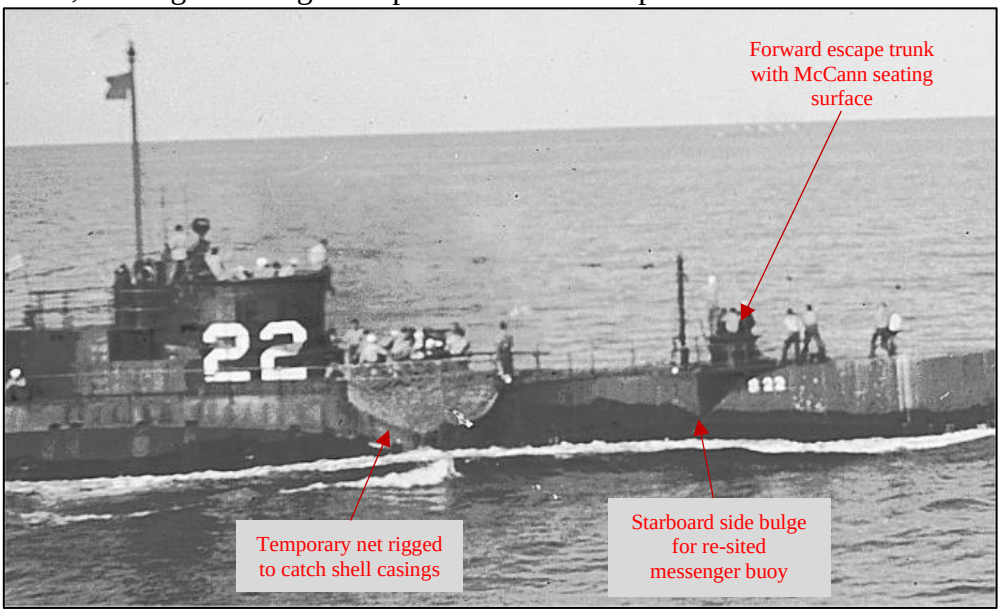

Fig. 15. S-22 at gunnery practice, 1938 or 1939. Photo courtesy of PigBoats.COM.

OTHER VARIATIONS

S-19 (Figure 16) was a Quincy built member of the 20 series group. For a reason unknown to the author she received the rounded bow plane pivot housing of the San Francisco built 30 series units. She retained them for her entire service life. Apart from this exception, she was identical to her 20 series sisters.

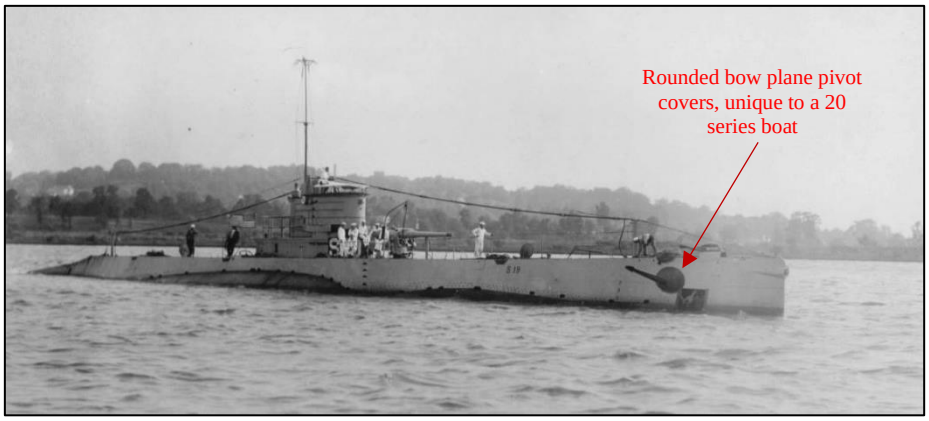

Fig. 16. S-19 shown underway in the Thames River, CT. approximately 1924. NARA photo 19-N-11053 via Navsource.

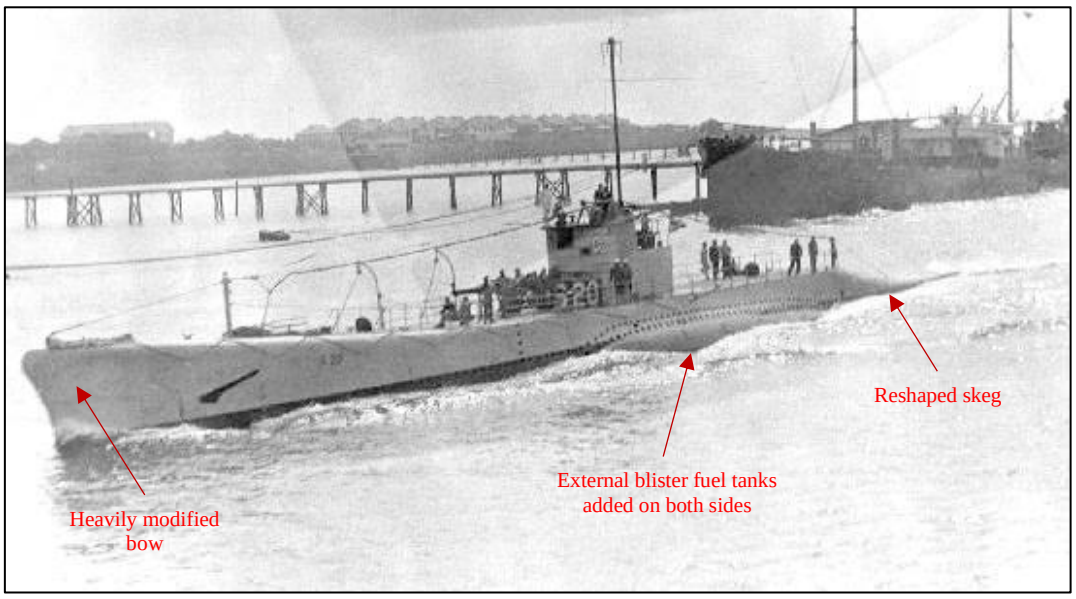

Fig. 17. A heavily modified S-20 underway in the late 1920s in the Canal Zone. USN photo NH-94167 via PigBoats.COM.

In late 1924, *S-20* (Figure 17) became a test ship for modernization schemes then being proposed for the S-boats. Her bow was completely rebuilt for better sea keeping, the design serving as a test bed for the later *V-1* class fleet boats. She had external blister tanks installed on each side of the boat that held an additional 5889 gallons of fuel. The skeg was cut away and reshaped (although to a lesser extent than the other boats) and an escape hatch installed in the motor room. She also had many other internal modifications and updates. These modifications were not successful enough to warrant follow-ons (they were also quite expensive) and she was the only boat to receive them. In 1931 she became an engineering test ship and had a variety of engine configurations installed during the rest of her career. In the spring of 1945 she tested an early experimental snorkel induction mast.

In looking through pictures of the S-class boats through a variety of time periods, you will notice that there were several different schemes as to how the boat's name was displayed on the exterior. The earliest standard had the boat's name in white block letter/numbers without a dash painted on a black field at the forward lower end of the conning tower fairwater (see Figure 9). Later schemes had just the number portion without the letter painted in shaded white on the haze gray background (see Figures 6 & 11). Another scheme seen on the Government design boats had just the number painted on a black field on the *upper front* of the conning tower fairwater. Later, as the boats were painted in an overall flat black in the

mid 1930s just the number portion would be painted in white on the side of the fairwater (Figure 15). By

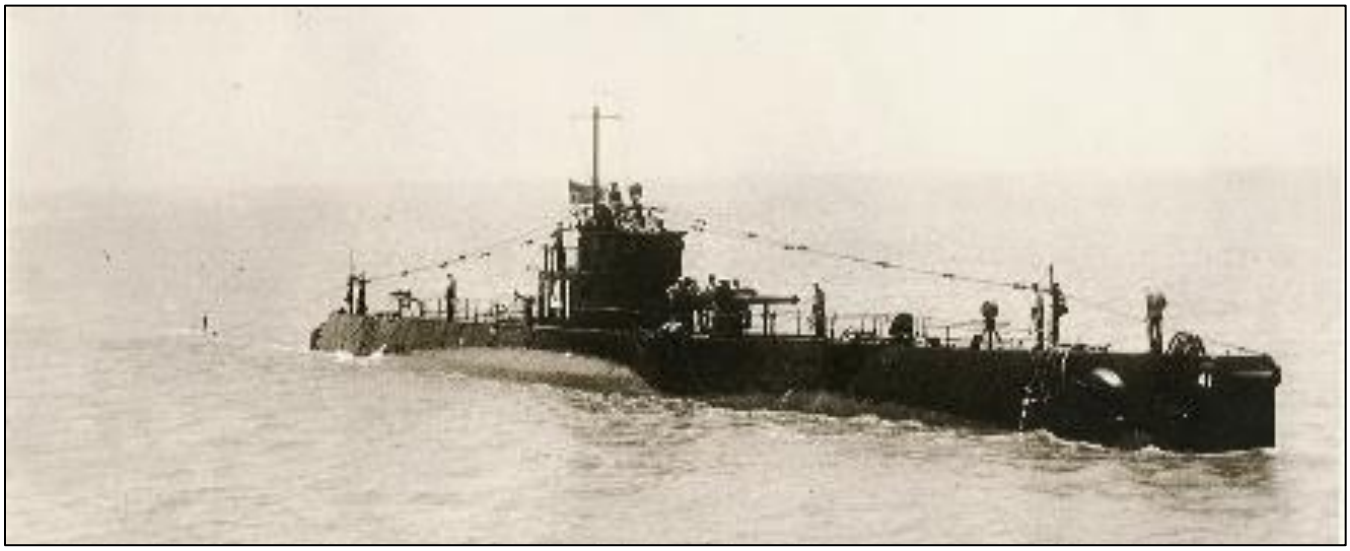

Fig. 18. USS S-36 (SS-141) off Tsingtao, China in the late 1930s. The boat's name on the fairwater has been replaced with her hull number in accordance with a newly developed fleet standard. Photo courtesy of Mike Kaup via PigBoats.COM.

the end of the 1930s, all USN submarines received a standardized exterior identification scheme, which had the boat's hull number (not to be confused with her actual name) painted on the side of the fairwater (Figure 18). With the exception of the last case, some of the variations are most likely local schemes adopted by regional commands, such as the Asiatic Fleet in the Philippines and Submarines, Scouting Force, U.S. Pacific Fleet in Hawaii.

WARTIME UPGRADES

By the fall of 1941 most of the S-boats had been in continuous service for over 15 years. Many of the Government design boats, with their slow diving times and their sluggish underwater maneuverability, had been decommissioned and scrapped under the provisions of the 1930s disarmament treaties. The EB design *S-19* was among those decommissioned early. She had run aground off the coast of Massachusetts in 1925 and had been heavily damaged. Although repaired and put back into service she suffered some long term effects from the grounding and it was decided to let her go in order to stay within the tonnage limits of the treaties. The rest of the EB design boats soldiered on throughout the 30s, forming the nucleus of the USN's Submarine Service. The privations of the Great Depression had imposed some severe limits on maintenance and as war loomed in the fall of 1941 most of the S-boats were suffering from a variety of maladies, brought on by age and lack of maintenance. The lack of sufficient quantities of much more capable Fleet Submarines forced the Navy to retain the S-boats as they still made up a significant percentage of the force. At the commencement of hostilities most of the boats were still in their 1930s configurations as described previously, with the exception of being repainted in a flat black. After a series of harrowing patrols early in the war, the surviving S-boats were brought back to the States for complete overhauls and in some cases significant modernization. These modernizations including reducing the size of the conning tower fairwater, adding radar, updating sonars, adding air conditioning and topside gun platforms, and rebuilding the aft superstructures. There was no set pattern to these changes and some were unique to specific boats.

S-28 is shown on 24 June 1943 in Figure 19. She has a rebuilt aft superstructure, the aft extension of her conning tower fairwater removed, the access hatch moved down to deck level, and a raised gun platform built above this hatch. She has one of the early enclosed Mk 5 pedestal mounts for a 20 mm AA

gun on this platform. She is also sporting an SJ radar above and aft of the bridge. On her forward deck the ball shaped object is the high frequency JK sonar, sitting on top of the T shaped low frequency SC tube array. The JK is actually a flat panel. Original installations showed that water turbulence over the panel rendered it virtually useless with the boat moving above 5 knots. The solution was a hollow rubber ball to cover the array. This reduced flow noise so much that it effectively doubled the boat's maximum sonar listening speed.

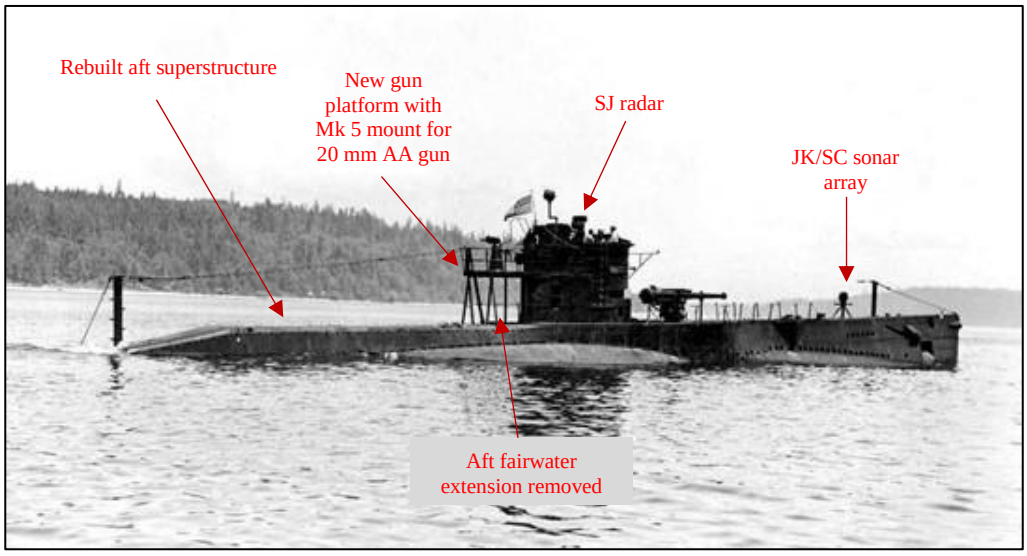

Fig. 19. S-28 shown underway off the Puget Sound Navy Yard, 24 June 1943. She has gone through an extensive overhaul and modernization. She would be lost off Hawaii in an accident just one year later. NARA photo 80-G-176129 via Navsource.

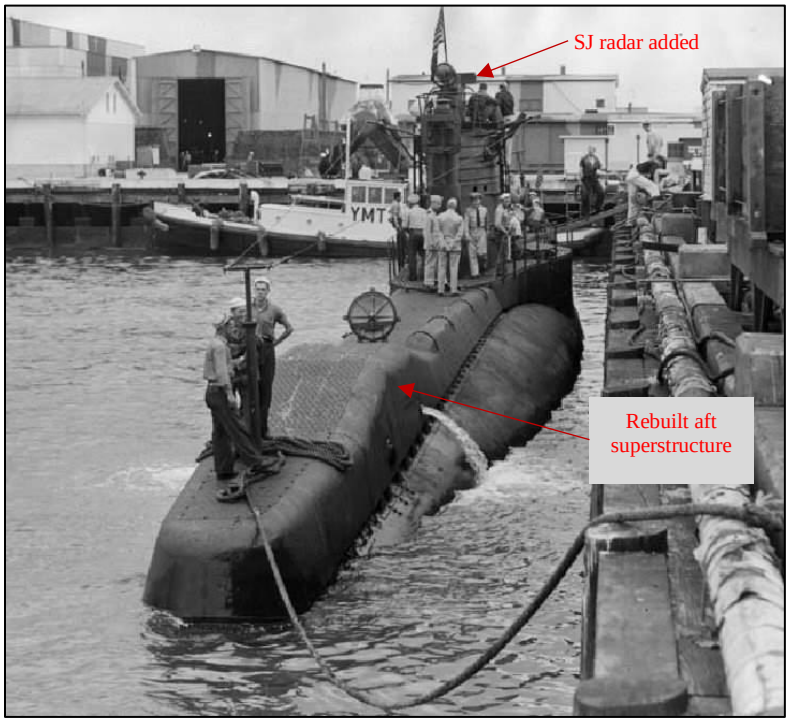

Fig. 20. S-38 pierside in San Diego at the 32nd Street base, April, 1943. USN photo NH-1198-43 via Navsource.

Figure 20 shows *S-38* with a completely new aft superstructure, installed during a 1943 overhaul. The messenger buoy had been deleted on fears that it would break loose during depth charge attacks, and the old superstructure was so rickety from corrosion that it needed to be entirely replaced. At least 12 of the surviving EB design S-boats received modifications and modernizations similar to this. The prominent hump covered newly installed water-injected main engine mufflers. She has also received SJ surface search radar, barely visible above the bridge.

S-42 through *47* were extensively rebuilt from the conning tower aft and thoroughly modernized. The forward end of the conning tower fairwater was rebuilt and a gun platform added there. SJ and SD radars, air conditioning, and a new JK/SC sonar combination was added. Except for *S-44* (lost in October 1943) they all had their 4"/50 caliber Mk 9 deck guns replaced with the smaller 3"/50 caliber Mk 17 gun. The more powerful weapons were needed on the fleet boats, and by mid-war the lower priority of the S-boats dictated the change. Figure 21 shows *S-47* with the later Mk 10 open pedestal mount for the 20 mm automatic cannon on the newly built fairwater gun deck. These modifications allowed the surviving S-boats to provide good service to the end

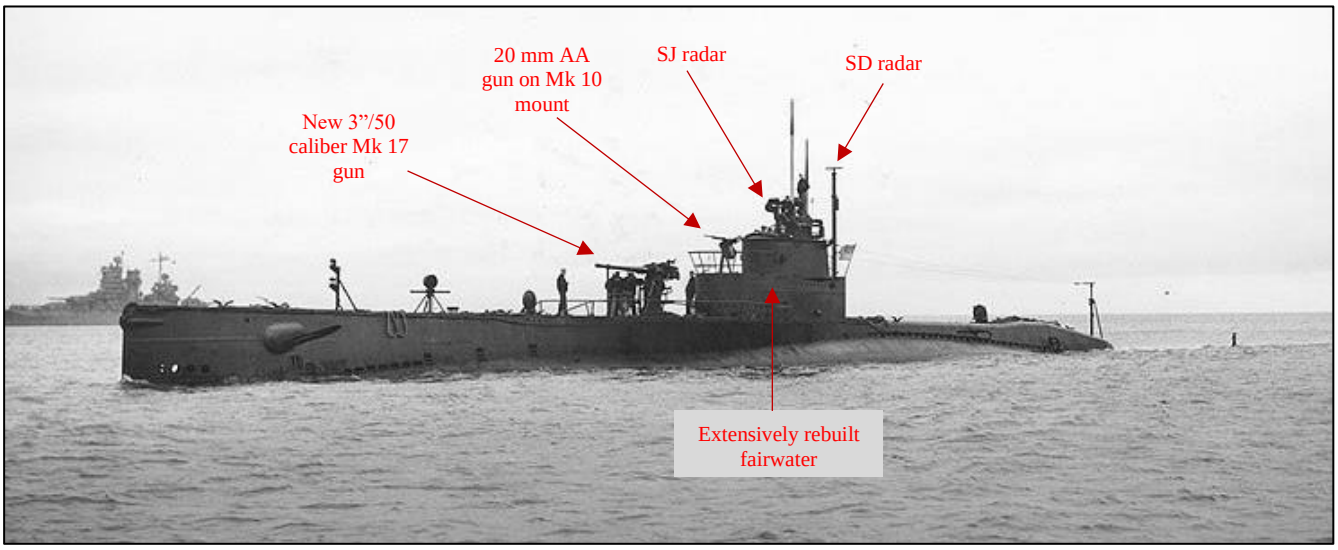

Fig.21. S-47 after a major overhaul and modernization in San Francisco, 07 September 1943. Note the New Mexico class battleship in the background. USN photo NH-42192 via Navsource.

of the war, although most had been pulled from front line patrol duties as quantities of the *Gato*, *Balao*, and *Tench* class boats became available. They were returned to the States for a well earned semi-retirement as training boats.

END OF THE LINE

Six EB design S-boats (*S-1*, *21*, *22*, *24*, *25*, and *29*) were leased to Great Britain under the Lend-Lease Act. They were recommissioned in the Royal Navy as the *P-551* through *556* and provided good service to the RN. One boat, *P-551* (ex *S-25*) was eventually sold to Poland and renamed *Jastrzab*. She was mistakenly attacked and sunk by allied forces in 1942.

The Navy found little use for the ancient S-boats once the war ended. By 1945 they were thoroughly worn out and were no longer able to be upgraded. The last two active S-boats were the *S-42* and *S-43*, both of which were finally decommissioned on 07 December 1946. The *S-24*, having been sold to Great Britain as the *P-555*, was returned to U.S. ownership at the end of the war and the Navy retained possession of her hulk until 25 August 1947, when she was finally scuttled.

Fig. 22. A very weary HMS P-556 (formerly USS S-29) at rest at the John Pounds Scrapyard in Portsmouth, UK, in the mid 1970s. Photo by David Hill via Facebook.

Final honors for the entire S-class of submarines goes to the USS *S-29* (SS-134). Loaned to Great Britain as the *P-556* in 1942, she was returned to U.S. control in 1946 and her name stricken from the Navy list. On 24 January 1947, her hulk was sold to ship breakers and while enroute to her date with the cutter's torch, she ran aground under tow off Portsmouth, UK. Freed

after a bit, she finished her tow to the John Pounds salvage yard in Portsmouth, where she sat rusting away for the next 31 years (Figure 22). She finally succumbed in her valiant battle with the cutter's torch in 1978 when she was loaded up on a barge and shipped off to Spain for scrapping, 54 years after first being commissioned in the United States Navy. She was the last S-class submarine in existence.

ACKNOWLEDGEMENTS

This article would not have been possible without the photographs collected and published by Michael Mohl at Navsource.org and Ric Hedman at Pigboats.com. Ric and the eminent historian Jim Christley also provided valuable editorial advice. I would also like to offer my personal thanks to the late Rear Admiral Edward Ellsberg, whose 1929 book *On The Bottom* inspired me as a kid.

REFERENCES

U.S. Submarines through 1945: An Illustrated Design History, Norman Friedman, Naval Institute Press, 1995

The American Submarine: 2nd Edition, Norman Polmar, The Nautical & Aviation Publishing Company of America, 1983

The Dictionary of American Naval Fighting Ships, DANFS Online via the Naval History and Heritage Command, www.history.navy.mil.