The Application of Sacrificial Zinc Anodes to *Titanic's* Sternpost

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Introduction

The scope of this article will be rather limited. The purpose of this article is to address what I believe is a misconception about galvanic protection of *Titanic's* sternpost. The contention has been made that there were no sacrificial zinc anodes applied to *Titanic's* sternpost but rather, cement was applied to the sternpost. Since there are very few photos of *Titanic's* construction and fitting-out, *Olympic* evidence will be used to make the argument that there were, indeed, sacrificial zinc anodes applied to *Titanic's* sternpost.

The Galvanic Reaction

When two dissimilar metals are physically connected and immersed in an electrolytic solution like seawater, a galvanic current is created. Ions from the less reactive metal will flow toward the more reactive metal in the galvanic circuit. In the case of a ship like *Titanic,* iron ions in the steel are leeched from the steel hull structure and move toward the manganese bronze propellers in the galvanic circuit. This current will cause structural decay in the steel near the manganese bronze propellers.

To prevent damage to the hull steel, a third metal is added to the circuit. This metal must be more reactive than the steel. Zinc and aluminum are most commonly used for this purpose. When attached with metal-to-metal contact with the hull steel, the more reactive zinc ions are leeched from these sacrificial zinc anodes and move toward the manganese bronze. This application of zinc bars to the steel hull is called a "sacrificial zinc anode". The zinc anodes chemically and structurally decay instead of the steel. Whenever the ship is in drydock for any reason, the zinc anodes are replaced to maintain protection for the hull steel.

The sacrificial zinc anodes were likely cold-riveted to the steel hull with retaining brackets. When replacing the anodes, they would need to drill out the old rivets and the brackets and anodes would be replaced most likely with cold-set zinc rivets.

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The Application of the Sacrificial Zinc Anodes

The sacrificial zinc anodes were placed strategically near the manganese bronze propellers. Figure 1 is a photo of *Titanic* before launch which shows the locations of the sacrificial zinc anodes as they were originally placed on both *Titanic* and Olympic.

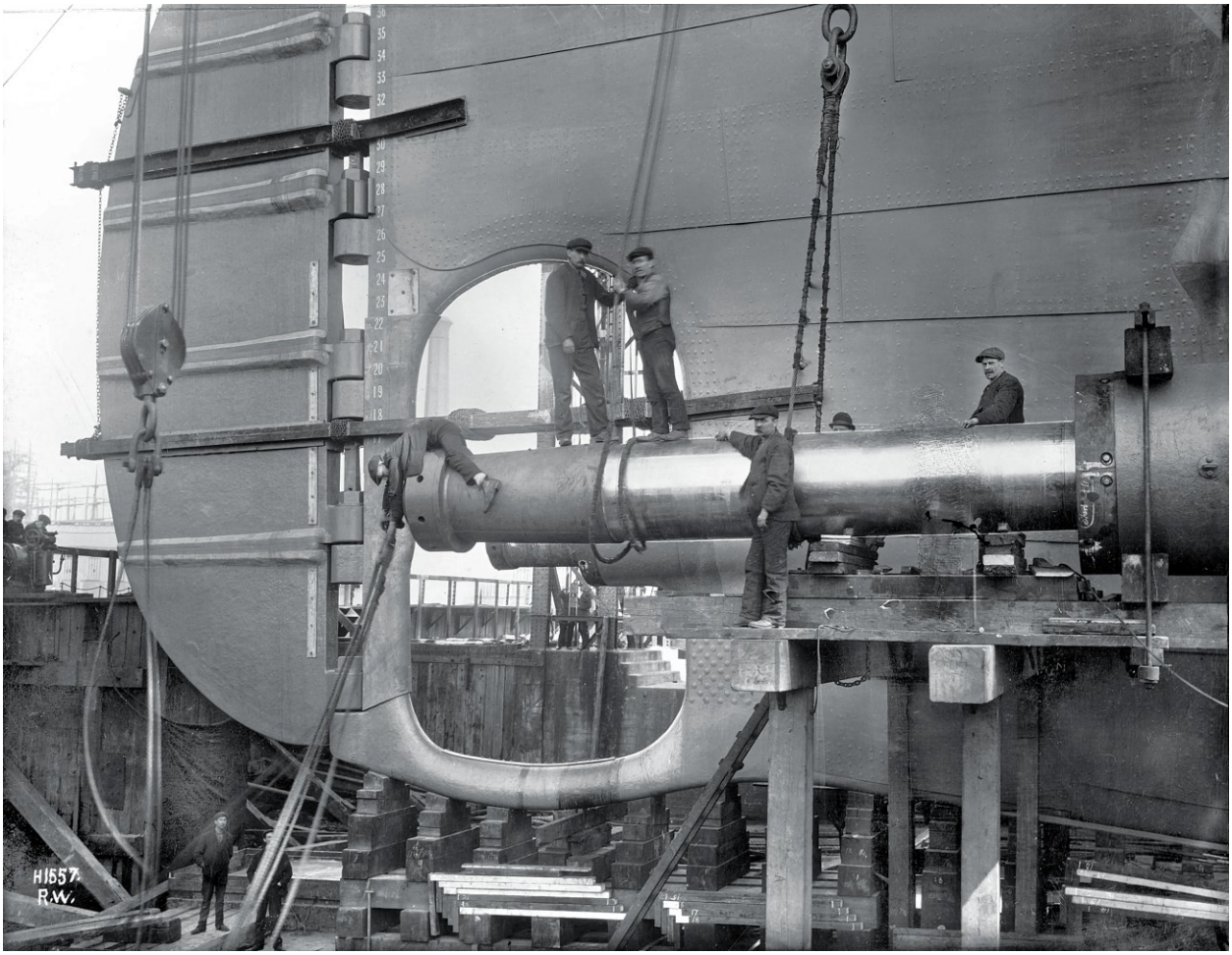

Figure 1

Titanic before launch with original sacrificial anodes in place

The rudder anodes were changed on *Olympic* in February 1912 when she was laid up for propeller repairs. Figure 2 shows the changes made to the rudder anodes.

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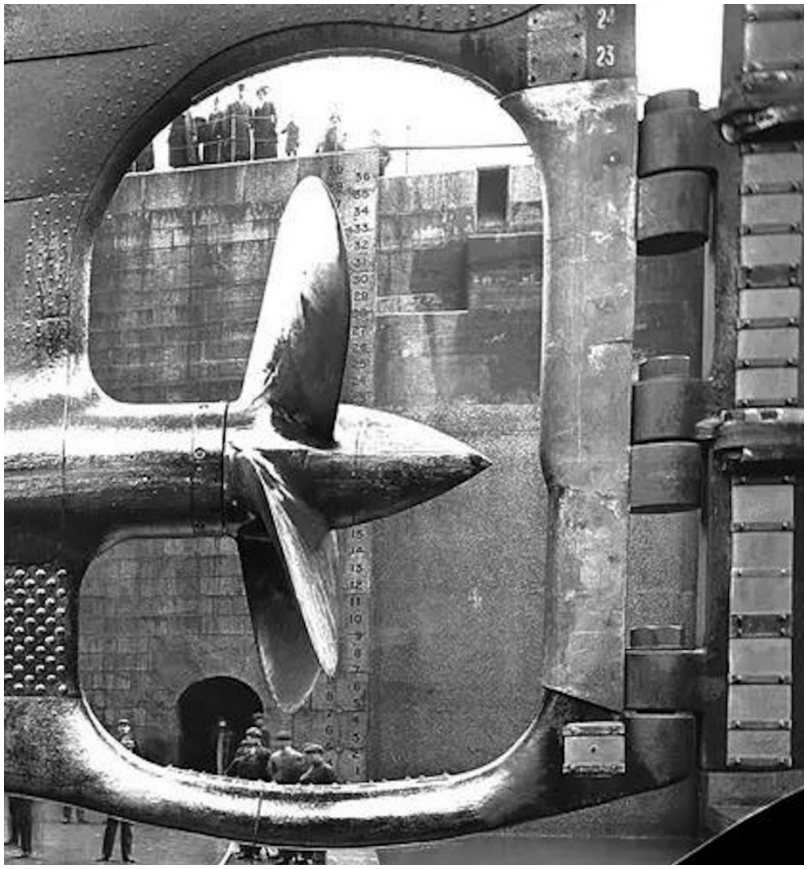

Figure 2

Olympic (Feb. 1912) in drydock showing new style of rudder anodes

It is believed that the original sacrificial zinc anodes on *Olympic's* rudder were not robust enough to resist the galvanic forces so they were replaced. After discovering this on *Olympic,* it is believed that the same change was made to *Titanic's* rudder sacrificial zinc anodes before her maiden voyage.

Was the sternpost sacrificial zinc anode painted?

One of the arguments put forward that the sternpost was coated with cement rather than an unpainted sacrificial zinc anode is its appearance in the pre-launch *Titanic* photo shown in Figure 1. The contention is that the sternpost is painted the same color as the lower hull. What we can see in the black and white photo is that the sternpost is the same ***grayscale*** as the lower hull. Pre-launch the lower hull was painted with red oxide. To show how a zinc anode could be the same grayscale as the red oxide painted hull yet be another color, Figure 3 is offered as an example.

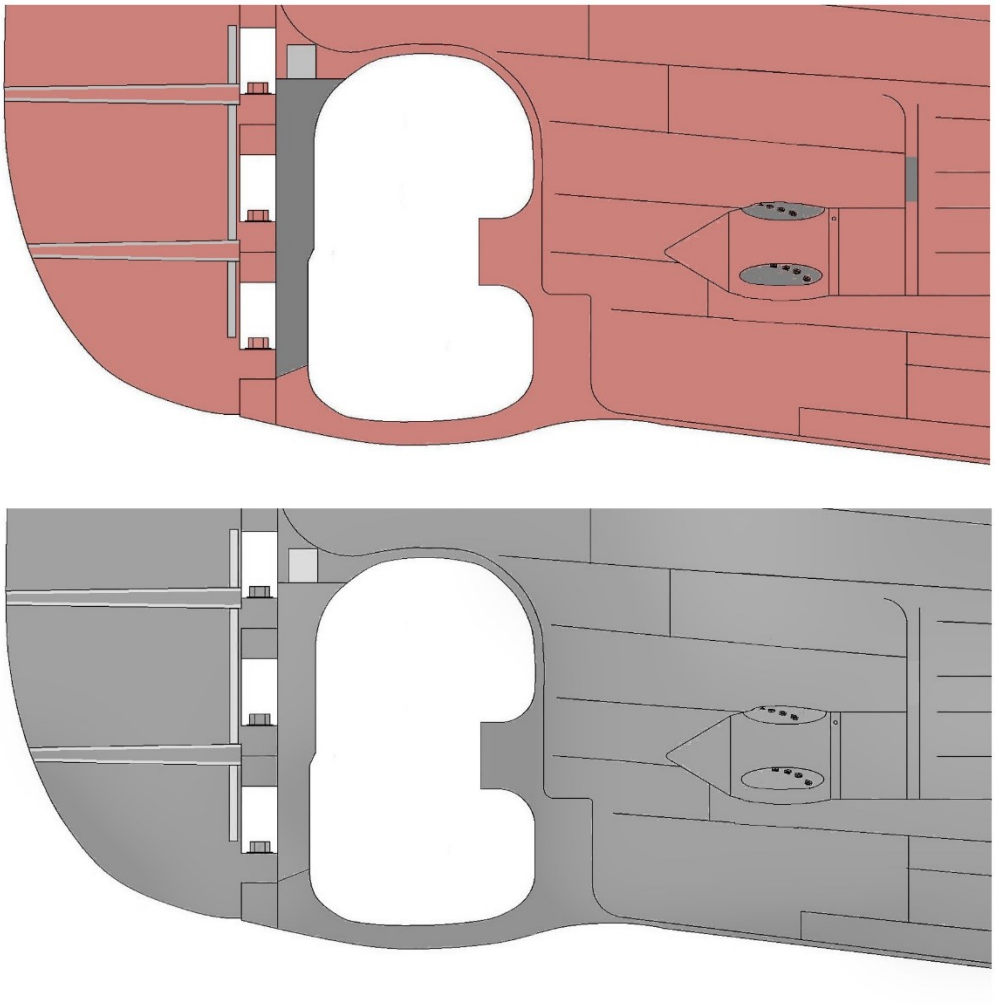

Figure 3

Sternpost sacrificial zinc anode of a different color than the lower hull paint yet the same grayscale.

Some might object that the other zinc sacrificial anodes in Figure 1 are a different shade than that of the sternpost. We don't know how long the sternpost treatment had been exposed to the elements and how it had oxidized relative to the other anodes. Our inability to fully explain the final appearance of the finished sacrificial anode does negate its existence.

Use of Cement Aboard *Titanic*

The primary use of cement aboard *Titanic* was as a waterproofing coating. It was used to coat the interior of water tanks to prevent rusting. The lead paints of the day could not be used for this purpose because of their poisonous properties. It was used where there would be standing water on a regular basis like waterways that couldn't be easily repainted. In the aft area of the

ship, it was used to physically seal the large nuts and bolts used to retain the wing propeller blades and also the nuts and bolts used to join the rudder sections. This cement coating kept water from entering into the small spaces between the bolt threads and the nuts which would keep them from rusting.

Cement was ***never*** used as galvanic protection. It is a misconception to suggest that it could be used in lieu of zinc sacrificial anodes. If cement were applied to the sternpost in the relatively thin thickness that we see, it would flake off in short order, not having any mechanical retention as exists around the nuts and bolts of the propeller blades and rudder sections. Cement has great compressive strength but unreinforced it has very little shear strength to which it would be subjected in an application to a sternpost.

Appearance of the Zinc Sacrificial Anode on the Sternpost

In addition to the objection that the sacrificial anode appears to have the same relative grayscale in black and white photos which has been discussed, another objection is the uniform appearance of the anode on the sternpost. The absence of visible rivet heads and an appearance which would suggest molding are offered as arguments that this couldn't be a zinc sacrificial anode. The smooth surface of the sternpost would be desirable to streamline the flow of water. The question then is whether a zinc sacrificial anode could conceivably be made to match the appearance we see in photos. I would suggest the following procedure as a possibility. The roughly 17 ft. anode could be stamped in the forge into an open die. The anode could be attached to the sternpost with countersunk flush blind rivets which would give a smooth appearance. Even if this is not the exact method they used to produce this anode, producing a single piece anode that could be changed relatively easily was well within the metalworking capabilities of that period and would offer time-savings in that no time-consuming procedures would have to take place in drydock.

Olympic Objection

In 1922 a major repair to Olympic's sternpost was made. This repair can be seen in Figure 4. This photo was taken in drydock in 1924. Because there is no zinc sacrificial anode apparent over the repair area it has been deduced that the sternpost in this area did not require galvanic protection. The question must be asked how a steel repair could provide galvanic protection. The answer is that it could not. Since this photo is taken in drydock in the midst of maintenance work, couldn't the answer be that the previous galvanic anode has been removed and the new one has not yet been installed? To make the assumption that galvanic protection was no longer needed because of a repair to the sternpost appears unwarranted. In the photo we also see

sacrificial zinc anode plates applied below the repair area which would negate the argument that the sternpost did not require galvanic protection.

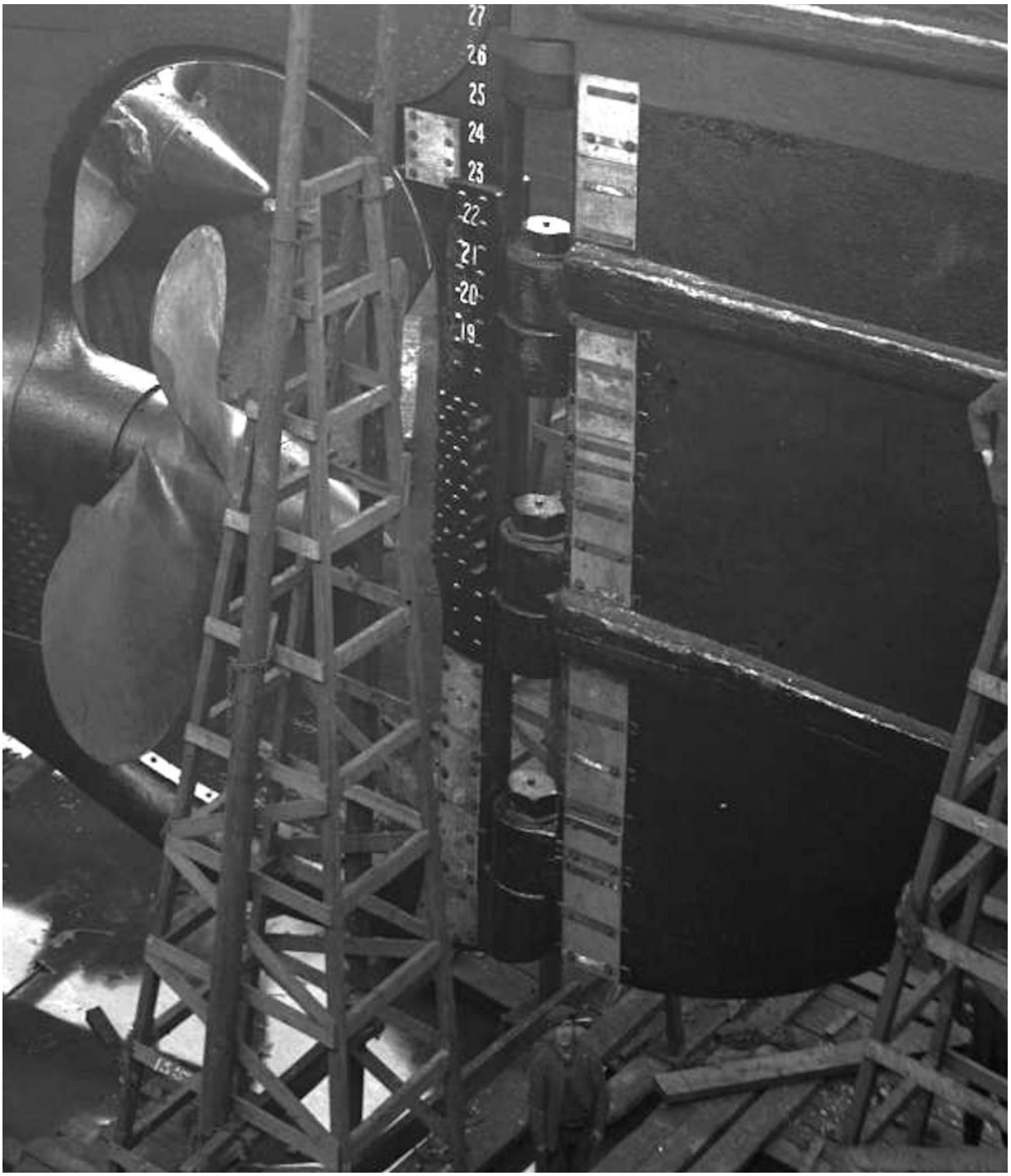

Figure 4

Olympic in drydock in 1924

Analysis

There is no convincing argument that *Titanic's* sternpost did not need galvanic protection in the form of a zinc sacrificial anode. There is also no convincing argument that cement applied to *Titanic's* sternpost could provide galvanic protection. The logical conclusion would be that since the sternpost needed galvanic protection and cement does not provide such protection, therefore what we see on *Titanic's* sternpost ***must*** be a sacrificial anode. This logic cannot be negated by photos of the *appearance* of Titanic's sternpost. Photos in the era of monochromatic black and white film can be explained. Fabrication processes were well within the capabilities of Harland and Wolff to explain the physical appearance of the zinc sacrificial anode on *Titanic's* sternpost.

Conclusion

This article has sought to offer arguments to make the case that what we see on *Titanic's* sternpost is a sacrificial zinc anode rather than an alternate proposal that it is cement applied to the sternpost. Arguments and illustrations have been offered to try to explain what we see in *Titanic* and *Olympic* photos. In the end, the requirement for galvanic protection on *Titanic's* sternpost seems inescapable despite any perception to the contrary in photos.