



Royal United Services Institution. Journal

Publication details, including instructions for authors
and subscription information:

<http://www.tandfonline.com/loi/rusi19>

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Published online: 11 Sep 2009.

To cite this article: Lieut. J. Townsend Bucknill R.E. (1873) Description of the Torpedo Boats "Fortune" and "Triana," United States' Navy, Royal United Services Institution. Journal, 17:73, 539-542, DOI: [10.1080/03071847309417807](https://doi.org/10.1080/03071847309417807)

To link to this article: <http://dx.doi.org/10.1080/03071847309417807>

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I am free, gentlemen, to admit that my account of the Austrian Army has been far from complete; yet, if it induce any one of you to enter into closer acquaintance with a body with which our service is knit by the bonds of mutual esteem, my object will have been fully attained. I have now but to express my sincere acknowledgements to you, Sir, for the honour you have done me in presiding here to-day, and to you, gentlemen, for the consideration with which you have been pleased to listen to my narrative.

DESCRIPTION OF THE TORPEDO BOATS "FORTUNE" AND "TRIANA," UNITED STATES' NAVY.

By Lieut. J. TOWNSEND BUCKNILL, R.E.

THESE vessels were employed as tugs during the civil war, and were lying at the Washington Navy Yard in January, 1872. One of them, the "Fortune," had then been converted into a torpedo boat, and was in commission, but the other was undergoing a refit and alteration, so as to convert her into a similar torpedo vessel.

The navy yards of the United States are all open to the public, and, although I could gain very little information respecting these torpedo boats, I was enabled, by a hurried inspection of the "Triana," to take the following details, the *approximate* accuracy of which can be relied upon:

Size, 170 to 180 tons.

Length over all, 130 feet.

Beam, about 25 feet.

Draught, from 8 to 9 feet.

Engine 125 H.P. single vertical cylinder, direct acting.

Speed, 7 knots.

Burns 11 tons of coal in 24 hours.

Carries 95 tons.

Rig, fore and aft schooner, pole-masted.

Spread of canvas unknown, but small.

Freeboard, about 5 feet.

Bulwarks, about 3 feet.

Top-hamper, as usual, with American tugs.

The deck of the "Triana" had been removed, and she was being strengthened throughout, but more especially in those portions near the bow.

About 4 or 5 feet below the normal water-line, an iron nozzle was fixed in line with the stem or fore-foot by means of two ears, which were riveted to the sides of the vessel. This nozzle, which projected in front of the stem, was bored out to form a hole a little over 10 inches in diameter, and in the top of the nozzle a large U-shaped aperture was made, into which an iron door could swing when the torpedo was pushed from the interior of the vessel, Figs. (5), (2), (3). This door, in its normal

position, hung by its own weight vertically across the opening, which led into the interior of the vessel by a large brass pipe (10 inches diameter internally) that was attached to the inner side of the nozzle. This pipe, as well as the nozzle, had an inclination upwards towards the stern of about 1 in 6, or 1 in 5, and at a distance of, apparently, some 7 or 8 feet from the stem, the pipe terminated in a flange by which it was attached by screw bolts to a valve box, as shown in figs. (4), (1), containing a valve to be worked by hand. To the inner side of the valve-box another brass pipe was attached by screw bolts, and the pipe was only cylindrical for a distance of 12 or 14 inches, after which the upper half was entirely cut away, see fig. (1), and a slot made in the lower portion, as shown in fig. (6). The segmental portions were supported on three brackets (a) (b) (c), figs. (1), (7), (8). The bracket at (a) was made in two separate pieces, so as to give room for the motion of a wheel (w) (12" diameter), grooved to carry a $1\frac{1}{2}$ " wire rope. The brackets (b) (c) were provided with a deep central slot, so that the wire rope could work through them, see fig. (8). Behind this arrangement were four larger cast-iron brackets, placed at central intervals of about 4 or 5 feet. Upon these, and in the brass tube before-mentioned, see figs. (1), (9), (10), slid the torpedo out-rigger, which consisted of a cast-iron tube some 23 feet long, $7\frac{3}{4}$ " to 8" internal diameter left rough, and having an external diameter of 10", obtained by accurate turning in a lathe. This tube weighs about one ton. The outer end that is projected in front of the vessel and carries the torpedo was reduced for a length of about one foot, to a diameter of 8" or 9", and was cast solid for 5" or 6" at the extremity, and a small hole, about $\frac{3}{4}$ " diameter, was bored centrally, through which the electric wires for the firing arrangement were to be led. The tube was to be run in and out by the wire rope before-mentioned. The rope was in two pieces, and the ends of each attached to a link that keyed to two small ears cast on the bottom of the tube at its inner extremity, figs. (11), (12). The remainder of each rope was coiled on the right and left side respectively of a grooved drum (9 grooves) about 20" diameter; thus, when one rope was coiled in, the other was slackened out, and *vice versa*. The drum was carried on suitable brackets fixed to the end of the wooden beam, and was turned by a cog-wheel of like diameter (72 cogs) gearing into a smaller wheel (24 cogs) driven by two handles worked by men standing on either side of the beam. On one side of the drum was fixed a pawl and ratchet. To the inner end of the tube an iron guide $\frac{1}{2}$ " \times $1\frac{1}{2}$ " was studded; this engaged in a groove $\frac{1}{2}$ " \times $\frac{1}{2}$ " cut in the side of a rail bolted to the brackets and brass piece, see figs. (13), (14), (1), and the tube was thus prevented from turning as it was run in and out.

About 16" from the inner end of the tube, a 1" screw plug was fixed in the top, it projected about $2\frac{1}{2}$ or 3 inches; its use I could not discover. See fig. (11).

Should the wire rope slacken by stretching it could be taughtened up by the arrangement shown in figs. (1), (15), (16). The axle of the wheel (w) was suspended by two hanging arms pivoted on the brass pipe just inside the valve box, and a forked arm engaged the axle

inside these arms. This forked arm terminated in a $\frac{3}{4}$ " rod threaded at its extremity to receive two nuts. The rod passed through a lug cast on the bottom of the valve box, and by altering the set nuts on either side of this lug, the wire rope could be tightened up or slackened off as required.

I was informed that the torpedo employed was of cast iron, about 4 feet long and 10" external diameter, and that the charge was contained in an internal copper cylinder. Also, that the torpedo case was attached to the end of the tube by an iron ring fitting on the reduced part of the tube and over the inner end of the case. This ring is destroyed by the explosion of the torpedo, but the tube remains uninjured, the charge being limited to 100 or 120 lbs. of "cannon" gunpowder. I was informed by a high authority, that it was possible to load, run out, fire, and run in, in from three to four minutes, and that the arrangement gave the greatest satisfaction.

In the "Triana" class of torpedo boats, a bulkhead was placed about 42 feet from the bow; behind this, was stowed the coal, and then came another bulkhead, 20 feet behind the first. A powerful steam bilge pump was fixed in the forecastle as an additional precaution. Portions of the engine and boiler were above the water-line and much exposed to shot. The steam was super-heated in a dome surrounding the funnel, at least 10 feet above the deck. To a certain extent these vessels are experimental only, but several vessels (number unknown) of the United States' Navy, ostensibly tug and despatch boats, are in reality torpedo-boats fitted up on the tubular principle described, or on some modification of it. In some, the tube is thrust out by a screw worked by steam power, but the arrangement described was preferred as being the simplest and best.

It is, I think, evident that the Americans have in this apparatus sought as much as possible to minimize the mechanical intricacies, to a certain extent inherent in this class of torpedo, and if the information I received be correct—viz., that several vessels are armed in this manner, it would appear that the Americans are thoroughly satisfied with the arrangement.

One of the first considerations obtained by investigating this apparatus, is that the experiments of a foreign Power have disclosed the fact that it is possible to fire a charge of 100 or 120 lbs. of Mammoth powder or "cannon" powder at the end of a cast-iron tube, of the dimensions given, *without damaging that tube*. Doubtless a very small charge of dynamite, duolin, compressed gun-cotton, or nitroglycerine, would, if detonated in the same position, utterly destroy the cast-iron tube. This fact being digested, the next consideration and question that arises is, whether 100 lbs. of common gunpowder exploded 7 or 8 feet below the surface, and in contact with the outer skin of an iron-clad will cause great damage to such a vessel? Another question suggests itself. Could not a similar apparatus be placed inside the stem of our existing ironclads? If so, would not the ramming power of such a vessel be enormously enhanced? But the Americans do not seem as yet to have applied this plan of working a torpedo from the interior of a vessel to any of their frigates, corvettes, or other cruisers; and

I was unable to discover what apparatus they intended to fit or board the three new torpedo-vessels they had commenced the year before last.

The following are some of the advantages obtained by the employment of the tubular arrangement for outrigging-torpedoes that has been described in the foregoing paper:

1. Ease of fixing and working the torpedoes from a position of comparative safety.

2. Quickness of the operation of re-fixing, booming out, &c.

3. Vessel not impeded, or her speed lessened by the apparatus, the tube not being thrust out until just before it is intended to use it.

4. Everything out of sight of the enemy, and the vessel's true character thereby concealed.

5. By the use of the electric, in place of the chemical fuze, danger to friendly vessels is minimized, and accidental explosions from the torpedo striking against any snag or other impediment, prevented. Moreover, the explosion of the torpedo when in actual contact with the enemy's vessel is ensured and the chance of a failure, such as Captain Davidson experienced when he rammed the "Minnesota" with the Confederate torpedo boat "Squib," and which he attributed to the slowness of action of the chemical non-electric fuze allowing the "Squib," to recoil a short distance before the torpedo exploded, is by the use of the electric fuze guarded against; for it is easy to arrange the electrical portion of the apparatus so that the torpedo can be fired either by judgment or by contact, the former being only resorted to when the contact-arrangement fails to perform its functions. I was unable to discover what the electrical arrangements used by the Americans on board the "Triana" class of torpedo vessels, actually were.

In conclusion I would beg to point out that the Americans seem to have paid more attention to the torpedo-apparatus itself than to its protection from an enemy's shot. This consideration has been carefully thought out elsewhere, and we have only to combine in the same craft the tubular arrangements described in the foregoing paper, with the almost shot-proof deck and noiseless engines of other existing and known types of torpedo vessels to obtain a thoroughly trustworthy and efficient class of vessels for use on our coast defences.

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