SECTION VI

U.S.S. TUNNY (SS282)

Depth Charge Damage Forward

Off Palau Islands
26 August 1943

Class.....SS212

Builder.....U.S. Navy Yard, Mare Island

Commissioned.....1 September 1942

Length (Overall).....311 ft. 8 in.

Beam (Extreme).....27 ft. 3-1/4 in.

Submergence Depth (Designed Maximum) (Axis).....300 ft.

Displacements

Standard.....1525 tons

Emergency Diving Trim.....1946 tons

Submerged.....2410 tons

Draft (Mean, Emergency Diving Trim).....16 ft. 2 in.

Type of Propulsion.....Diesel Electric Reduction Drive

Main Engines (4).....Fairbanks-Morse 38-D-8-1/8

Main Motors (4) and Generators (4).....General Electric Co.

References:

(a) C.O. TUNNY conf. ltr. SS282/A16-3/A9, Serial No. C-16 of 8 September 1943 (Report of War Patrol Number Four).
(b) C.O. TUNNY conf. ltr. SS282/S9, Serial No. C-18 of 15 September 1943 (Report of War Damage).
(c) OinC U.S. Naval Drydocks, Hunter's Point conf. ltr. SS282/L11-1 (06566); (308) of 8 March 1944 (Supplementary Report on TUNNY War Damage).

Photographs Nos. 6-1 through 6-7 (furnished by C.O. TUNNY, Naval Drydocks, Hunter's Point, and Bureau of Ships)

PLATE VI

6-1. On 26 August 1943, during her fourth war patrol, TUNNY underwent a severe depth charge attack off the Palau Islands. Two charges detonated close aboard the bow while the ship was submerged to a depth of 300 feet, causing extensive structural damage to the single hull plating and framing in way of the forward torpedo room and considerable other damage throughout the boat. Although depth control was temporarily lost, due to jammed bow planes and brief cutoff of main power, TUNNY was able to remain submerged and make good her escape. This report is based on the information contained in the references and on informal interviews with various officers attached to TUNNY. The Photographs were furnished by C.O. TUNNY, U.S. Naval Drydocks, Hunter's Point, and this Bureau. The PLATE was prepared by the Bureau and the structural indentations noted thereon are based on data contained in the enclosures to reference (c).

6-2. TUNNY arrived at the Submarine Base, Pearl Harbor, on 14 July 1943 from her third war patrol. Following normal refit and training, she departed Pearl Harbor for Midway on 5 August and arrived on 9 August. Here minor voyage repairs were made and fuel and lubricating oil were topped off. On 10 August TUNNY departed Midway for her fourth war patrol and on 22 August reached her assigned patrol area in the waters adjacent to the Palau Islands.

6-3. On 25 August TUNNY damaged two medium-sized freighters out of a six-ship Japanese convoy by one torpedo hit each during a pre-dawn submerged attack. Further attacks against this convoy were terminated when TUNNY was forced to take evasive action by an enemy destroyer escort. After the escort had retired and the safety of darkness permitted, TUNNY surfaced and remained on the surface until near dawn on 26 August , submerging again at 0412.

6-4. At 0959, 26 August 1943, while still submerged, periscope contact was established with two medium-sized Japanese freighters approaching from the south, escorted by one aircraft (DAVE) and one PC type surface vessel. TUNNY was at this time in a position off Toagel Mlungui Pass about 3,000 yards outside the reef to westward of Babelthuap Island, lat. 7°30' N., long. 134°20' E. At 1037, after closing to make a submerged periscope attack and with the enemy PC only 400 yards off her starboard beam, TUNNY fired a spread of three torpedoes at the leading freighter from a range of 980 yards and two torpedoes at the second freighter from a range of 1260 yards. As the last torpedo was fired, TUNNY headed for 300 foot depth at full speed, rigged ship for silent running and depth charge attack, and commenced evasive action. On the way down, two hits on the first freighter were heard. The propellers of this ship stopped and were not heard again. The second freighter turned toward TUNNY, successfully avoiding both torpedoes, and passed directly overhead.

6-5. At 1058, 20 minutes after the attack, either the enemy PC or DAVE located TUNNY and dropped two depth charges or depth bombs. These detonated well above the ship and did no damage. Two minutes

later, at 1100, six depth charges were dropped by the PC in close pattern around TUNNY and in rapid succession, detonating a few seconds apart. The first two charges detonated fairly close over the after portion of the ship but caused no damage, with the possible exception of that which occurred to the control cubicle in the maneuvering room. The second two charges detonated amidships above the conning tower and, although closer, caused no structural damage and probably little, if any, shock damage. The last two charges detonated close to the bow, causing extensive structural deformation forward and considerable damage to fittings and equipment throughout the boat. After this attack, no more depth charges were dropped, although the enemy vessel remained in TUNNY's immediate vicinity for several hours.

6-6. From the location and degree of deformation which occurred to the forward pressure hull structure, it appears that the last two depth charges detonated port and starboard abreast the forward trim tank at or just below the level of the pressure hull axis. All six charges were probably of the Japanese Type 95, Mod. 2 design, containing 242 pounds Type 1 explosive, and were probably set by pairs for detonation at 98, 197 and 292 feet. Since TUNNY was submerged to a depth of 300 feet, the setting of 292 feet, which was the maximum setting possible with the Type 95 depth charge pistol, would have resulted in detonation at the proper depth to correspond with the damage which actually did occur. Based on known behavior of similar type structures when subjected to underwater explosions, it is estimated that both charges detonated about 50 feet from the hull.

6-7. The depth charge attack had immediate serious effects on TUNNY. (a) Personnel forward were thrown from their feet and loose gear was hurled about. (b) Propulsion power was temporarily cut off by ship's force due to a fire in the main control cubicle which started when the positive and negative main battery busses jarred together momentarily. (c) Shortly afterwards, auxiliary power was also lost throughout the boat for several minutes when the auxiliary circuit breaker aft opened. The exact reason for this casualty is not known, but was reported by the Commanding Officer to have been due to maloperation of the auxiliary switchboard by personnel rather than material failure due to depth charging. This naturally added somewhat to the tendency for confusion which exists after any severe attack. (d) The bow planes jammed on 9 degrees dive angle due to misalignment and binding in the operating gear caused by distortion of supporting structure. (e) The upward water thrust from the depth charge detonations under the bow and the downward thrust from the detonations over the stern immediately caused the ship to assume a 20 degree up angle. Men were sent forward quickly in an effort to reduce this angle. The ship climbed to 200 feet but the angle on the boat then reversed, due to the bow planes being jammed in dive position and the added weight of the men sent forward. The ascent was followed by a steep glide to about 380 feet. Depth control was finally regained several minutes later, after much porpoising, by shifting from hand to power operation of the stern planes when auxiliary power again became available. The bow planes were then forced back to 5 degrees dive angle by using emergency hydraulic power; i.e., taking oil directly from the main hydraulic plant. However, the planes could not be tilted below 5 degrees by either hand or power operation. The damage control parties functioned coolly and efficiently throughout this period, restoring order and almost normal conditions within five minutes after the attack.

6-8. That TUNNY neither broached nor went excessively deep after depth control was lost was attributed by the Commanding Officer in large measure to the fact that the boat was fortunately operating at this time in a pronounced negative temperature gradient. This caused the boat to become heavy overall as it ascended and light overall as it descended.[1] The effect was sufficient to keep TUNNY oscillating within the water strata below 200 foot depth and above 380 foot depth.

6-9. After regaining propulsion power, TUNNY retired to the southwest at two-thirds speed, running at 360 foot depth and under the sonar protection of the temperature gradient. The enemy PC passed overhead once more but did not attack, either having no depth charges left or not detecting TUNNY's presence. At 1625, TUNNY commenced operating at periscope depth and secured from silent running. At 1858 she surfaced and proceeded to clear the area rapidly.

6-10. At this time it was felt that perhaps sufficient repairs could be effected to enable TUNNY to remain on patrol. Inspection of the topside revealed that the bow had received considerable damage. Numerous pieces of torn and twisted metal from the cases of the depth charges, about 15 pounds in all, were found scattered over the superstructure deck forward of the capstan. The bow buoyancy tank vent valve operating gear had jammed with the forward vent in closed position and the after vent only partially opened. In order that the boat might again dive, a permanent vent opening was made in the bow buoyancy tank top by removing the manhole access plate. By slacking off on the bow plane tilting shaft packing glands and applying liberal amounts of grease to the bushings, the planes were finally jacked back to zero tilt from within the boat and rigged in.[2] Work was started at once on the stern torpedo tubes, where it was discovered that all four gyro spindles had been bent and could not be withdrawn. All hands were kept busy restoring order and attempting repairs to deranged equipment.

6-11. By midnight of 28 August, everything within the power of the ship's force to put the ship in normal operating condition had been accomplished, but the following unsatisfactory conditions remained:

(a) Bow planes still could not be tilted either in hand or power operation, making depth control near the surface somewhat erratic.

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[1] For each degree F. change in sea water temperature in the vicinity of 70°F., assuming average salinity content and near surface conditions, the change in buoyancy of an SS212 Class will be of the order of 825 pounds.

[2] A modification to permit rigging bow planes over a wide tilt angle range of from 0° to 15° dive was authorized for SS198 and subsequent submarines by BuShips ltr. SS/S22(515-815) of 24 November 1944. Had this alteration been accomplished on TUNNY at this time, the bow planes could have been rigged in immediately, even though jammed on 5° dive.

(b) Bow buoyancy tank was unusable as such.

(c) Considerable air leakage through the 600-pound blow manifold for the forward group of main ballast tanks made it necessary to secure the individual tank hull regulator stop valves when submerged (this condition was present before depth charging).

(d) No. 2 low pressure blower was out of commission due to a short-circuited shunt field.

(e) The optics of No. 2 periscope were deranged, reducing light transmission by 25 per cent.

(f) The 1MC system on the bridge and in the conning tower was irreparably damaged.

(g) Two of the remaining eight torpedoes required a major overhaul.

(h) All forward torpedo tubes were out of line and out of round, preventing firing of torpedoes from these tubes.

(i) The JK-QC sound projector could not be trained.

6-12. Since the above conditions rendered TUNNY's offensive power negligible, it was decided to return to base for repairs and make her very active area available to another submarine. Therefore, at 0013 on 29 August, TUNNY departed for Pearl Harbor. The return trip was made entirely on the surface except for occasional dives when enemy or unidentified aircraft were sighted. Diving time without the aid of the bow planes was 60 to 75 seconds, somewhat slower than the normal time of about 45 seconds. TUNNY arrived at Submarine Base, Pearl Harbor on 8 September.

6-13. Structural damage was confined to the ship forward of frame 31. Damage to the elliptically shaped single pressure hull in this region consisted of minor distortion of the framing with marked general depressions of the shell plating between frames (PLATE VI, Photos 6-1 through 6-5). Transverse bulkheads at frames 10, 13 and 16 were slightly buckled. Bow buoyancy tank frames and plating were dished inward (Photo 6-6) and the superstructure deck plating was slightly buckled. Examination of the vessel revealed that the entire forward section had been displaced to starboard. This deflection increased from 1/8 inch at frame 37 (forward knuckle) to 1 inch at the bullnose. There was local bending of the stem bar to port between frames A and B, the maximum displacement amounting to about 2 inches at the 20-foot waterline (Photo 6-6). The bullnose was found to have moved upward 1/2 inch relative to the base line.

6-14. Deformation of the pressure hull plating was about equally distributed port and starboard (Photos 6-1 and 6-4). The maximum plating indentation on the starboard side was 2-1/16 inches in way of the forward trim tank between frames 13 and 14 at about the 14-foot waterline. General dishing of plating on the starboard side extended aft to frame 25 and was

concentrated between the 10-foot and 14-foot waterlines, depths of indentation averaging between 1 and 1-1/2 inches. Damage to the port side pressure hull plating was similar to the starboard side in nature and location, although it did not include as large an area. Minor isolated dents, not shown on PLATE VI, occurred both port and starboard.

6-15. The bossing for the bow plane tilting shaft sector gear, built into the overhead of the pressure hull between frames 16 and 17, was depressed both port and starboard to a depth of about 2 inches (Photo 6-5). Since no other pressure hull plating in this vicinity was affected, it was apparent that a structural weakness existed in the design of the bossed area. Another region of local failure was the section of the hull plating between the escape trunk and the torpedo loading hatch, which was depressed to a depth of about 1 inch over a distance of about four feet on either side of the centerline. However, no difficulty was encountered in removing the transverse compression strut in the torpedo loading hatch after the damage, demonstrating that the hull distortion was not sufficient to jam the strut threads.

6-16. All welded seams and butts in the pressure hull remained tight, even though some were severely distorted. Welds joining framing to plating were also undamaged. There was no leakage into the boat which could be attributed to depth charge damage.

6-17. Pressure hull frames 13 to 30 were found to deviate slightly from their designed offsets, maximum variation occurring in way of the forward trim tank and forward portion of the torpedo room. Considered as a whole, the starboard framing presented a fair surface although actually deflected outboard by amounts from as high as 3/4 inch to an average of only 1/4 inch. Maximum deflections occurred in the vicinity of the 5-foot waterline. There were no local depressions in any frames. Portside framing was, in general, pushed inboard, but deflections were less than on the starboard side. There was, however, some unfairness of framing. Maximum frame deformations on the port side occurred in the vicinity of the 13-foot waterline but varied from designed offsets by only 1/8 to 1/4 inch. These latter variations are insignificant and may well have occurred during construction of the vessel. PLATE VI illustrates the relative distortion of the pressure hull ellipse from the designed dimensions.

6-18. Bulkhead 10, the after bulkhead of the bow buoyancy tank, sustained only minor distortion but this was sufficient to jam the operating shaft for the bow buoyancy vent valves. Bulkhead 13, the forward bulkhead of the forward trim tank, was generally depressed aft between the torpedo tubes and the shell, port and starboard, with a maximum deflection of about 3/4 inch. This bulkhead leaked slightly around the tubes, allowing a small amount of water to enter the trim tank when submerged. Bulkhead 16, the after bulkhead of the forward trim tank, sustained only minor distortion but did move slightly relative to the torpedo tubes. This was evidenced by bright metal showing on the

tube collar shoulders, but the motion was not sufficient to shear the flat head screws securing the bulkhead collars to the tubes nor did any leakage into the boat occur.

6-19. Superstructure and bow buoyancy tank damage was minor. The side plating of the bow buoyancy tank was depressed between frames forward of frame 0, principally on the starboard side (Photo 6-6). The rolled deck gunwale plates, both port and starboard, were severely buckled between frames 17 and 18, indicating that the bow had been whipped upwards by one of the close detonations, putting the deck in compression in the region of the buckles. The deck plating forming the top of the bow buoyancy tank was cracked in one place only. This occurred as a result of a stiffener on bulkhead 10 pulling away from the underside of the deck.

6-20. One of the most serious results of the depth charge attack was the damage which disabled the bow plane tilting gear. The principal cause of this derangement was binding due to misalignment of the main herringbone pinion and the sector gear on the bow plane shaft, caused by the deflection of the forward trim tank bulkhead at frame 16 upon which this gear assembly was mounted. Secondary binding of the tilting shaft also occurred port and starboard at the pressure hull stuffing boxes and was caused by distortion of the elliptical hull. The bow plane rigging mechanism remained completely operable, although some misalignment of the transmission shafting was discovered afterwards when disassembling the equipment.

6-21. The only casualty which occurred to the main propulsion plant and associated systems and auxiliaries was the control cubicle derangement previously mentioned. Although the control cubicle was not shock-mounted, it withstood impact without damage to contactor groups or mechanical equipment. However, the positive and negative main battery busses in the forward contactor cell were momentarily thrown together, causing a small fire and considerable pitting of the busses (Photo 6-7).[1] Simultaneously, the battery selector lever jumped from the "Both Batteries" position to the "Forward Battery" position. The main motors were stopped for about one or two minutes to extinguish the fire and then were started again on the forward battery only. Damage resulting from the fire was negligible, but dense toxic smoke given off by burning glyptol insulating varnish on the bus bars made inspection of the cubicle difficult and forced several men to abandon the maneuvering room.

6-22. The lighting systems were not appreciably damaged, with the exception of numerous broken bulbs and a resistor in the forward engine room emergency lighting circuit which short-circuited and caused a full voltage ground across the forward battery. Since the boat was rigged for silent running, only the emergency lighting system was on at the time

[1] As a result of this casualty, the installation of phenolic insulation between the propulsion control cubicle main battery busses to prevent short-circuiting under shock was authorized by ShipAlt SS222 of 6 December 1943 for TUNNY and all other applicable submarines.

of the attack. Numerous gauges and meters were thrown out of calibration and a few sustained damage. Several thermometers in the engine rooms were broken. The shock effect was widespread throughout the boat and there was no apparent concentration in any one locality.

6-23. During the attack mercury spilled from the float chambers of both the master and auxiliary gyro compasses, putting them out of commission and necessitating dismantling for cleaning and readjustment. The glass cover of the gyro repeater on the bridge was broken and the instrument flooded. After the casualty occurred to the gyro compasses, the ship was steered by magnetic compass. The fact that the battery selector lever in the control stand had moved from the "Both Batteries" position to the "Forward Battery" was not discovered until about ten minutes after the attack occurred when it was noted that both magnetic compasses (tank type and boat) were behaving erratically. This was due to the fact that the compasses had been compensated a few days previously for the magnetic conditions present with the ship taking propulsion power from both the forward and after batteries. Drawing power from only the forward battery set up an unbalanced magnetic field of sufficient intensity to produce a deviation of as much as 30°.

6-24. The upper prisms of both periscopes were cracked. The power field of No. 2 periscope was out of focus and light transmission reduced by 25 per cent. Nitrogen pressure was lost in No. 2 periscope but the periscope was recharged to eight pounds.

6-25. There was only one major piping leak which developed as a result of the attack. This occurred at the high pressure air (3000-pound) receiving and distribution manifolds in the control room and caused great concern to all hands. The manifold assembly was installed in such a manner that it was supported principally by the piping leading to it, permitting large deflections under impact. The cone joint at the connection of the after high pressure air riser to the distribution manifold opened sufficiently to permit serious leakage but fortunately did not carry away completely.[1] Air pressure within the boat increased appreciably but the amount could not be measured since all barometers and manometers were damaged. Although there was considerable structural damage in way of the forward torpedo air impulse flasks, located outside the pressure hull, the flanged joints of the impulse piping both at the flasks and pressure hull remained tight and the banks did not bleed down. As previously mentioned, a valve leak in the 600-pound blow manifold supplying the lines leading to the forward group of ballast tanks necessitated securing the individual tank hull stop valves to prevent air from forming bubbles in those tanks. This leak was present before the attack but was aggravated by the depth charge detonations. Hydraulic lines and fittings generally remained tight

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[1] As a result of this casualty on TUNNY, and the similar experience of KINGFISH (SS234) on 23 March 1943, ComSubPac conf. ltr. FF12-10/S49/L11-1/70 of 20 November 1943 directed that the high pressure air receiving and distribution manifolds be rigidly bracketed together and to the hull on all submarines where existing support was not sufficiently rigid. NYMI Plan No. 65557 was developed as a typical bracketing arrangement.

except for several serious leaks in the control room. Numerous valves throughout the ship, regardless of location, partially opened under impact, the discs backing off the seats. Both the forward and after 225-pound service air lines had to be secured at the manifold until damage control personnel could check and reclose the valves in that system. For example, the 225-pound air valve to the conning tower[1] opened on each of several close detonations and was closed on each occasion by the Commanding Officer himself. Trim line strainers were partially clogged in the variable tanks when depth charging caused flaking of the plastic composition with which those tanks were coated.[2] All vent and flood valves were undamaged with the exception of the bow buoyancy vent valves, previously mentioned.

6-26. Both the SD and SJ radars were deranged by the impact of the depth charges, the SJ becoming inoperable. On the SJ, the cathode ray tube was damaged internally so that the registered sweep was only 2 inches wide, the magnetron tube failed, the triode tube jarred out of its socket and the bearing indicator slipped 10 degrees out of phase. The SD radar withstood the impact somewhat better. It could be made to pulse but was also badly out of adjustment and it was found necessary to renew thirteen tubes shortly after the attack, indicating that they were considerably affected by the impact. No damage to radio equipment occurred. There was no damage to the electronic portion of the sonar equipment but the drift stops on the port JK-QC sound projector crushed under impact, preventing it from training, and the starboard QB head was slightly dented. Both heads were operable electronically after the attack.

6-27. All forward torpedo tubes were found to be both out of line and out of round. The deviation in alignment was fairly uniform and was apparently due only to the displacement of the entire bow structure to starboard. The azimuth error varied from 13 minutes starboard on tube No. 1 to 15 minutes starboard on tube No. 6. In addition, all forward tubes were slightly bent along their longitudinal axis, the maximum deviation being 0.110 inches on tube No. 5. The bending occurred at the junction of the breech section of the tubes with the middle section, at the forward trim tank bulkhead. The monel screws securing these sections apparently loosened somewhat, for it was reported that the sealing compound around the screws backed out and slight leakage occurred into the tubes. The circular distortion of the tubes was such that it was found impossible to start a bore gauge in any of them, tube No. 6 being out of round by as much as .210 inches. The outer doors, shutters and operating gear on all tubes remained workable in spite of

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[1] The 225-pound blow line to conning towers was later removed on all submarines when that compartment was disestablished as an escape station.

[2] Due to its tendency to flake, this white plastic composition, formula 89 (Barrierkote) was subsequently removed from all submarine variable tanks and replaced with rust preventative compound (N.D. Spec. 52C18, Grade III).

the distortion to the intervening bulkheads. Tubes Nos. 1 and 4 were reported by reference (a) to have flooded as a result of the attack, the muzzle door gaskets presumably sustaining some damage. No misalignment or distortion occurred to the after tube nest. However, the after tubes were loaded and flooded at the time of the attack and movement of the torpedoes under impact within the tubes bent the gyro setting spindles and guide sleeves so that the spindles could not be withdrawn. All torpedoes were removed for checking and the spindle assemblies were replaced by the ship's force, using the one available spare and three taken from forward tubes. The stop bolt in No. 10 torpedo tube was also found to have been bent and this was replaced. Two torpedoes were so shaken up internally that they required a major overhaul beyond the capacity of ship's force. The other six were thoroughly checked and considered satisfactory.

6-28. Upon arrival at the Submarine Base, Pearl Harbor, TUNNY was immediately docked in the ARD-1 to investigate the extent of structural damage. She departed Pearl Harbor on 11 September 1943 and arrived at U.S. Naval Drydocks, Hunter's Point, on 17 September. Complete damage repairs, regular overhaul and the majority of the outstanding alterations were accomplished there. The entire forward torpedo tube nest was removed from the ship and repairs were made to the individual tubes prior to reinstallation. Renewal of the forward pressure hull structure was accomplished as indicated by the outlines on PLATE VI. TUNNY was returned to active service on 2 January 1944.

6-29. As a matter of interest, TUNNY was twice more seriously damaged by bomb attack on subsequent patrols, the first action occurring on 30 March 1944 during her fifth patrol and the second action occurring on 1 September 1944 during her seventh patrol.[1] On both occasions the bombs detonated in close proximity to the maneuvering room. In the first instance, control cubicle damage was again sustained although the cubicle was shockmounted during the overhaul completed just prior to the patrol. It is understood, however, that later examination disclosed that one of the cubicle transverse support frames was improperly placed so that it was in direct contact with the cubicle cage, thus nullifying the effect of the rubber mounting. This condition was corrected and it is significant to note that although in the subsequent action of 1 September 1944 the bomb detonated close enough to permanently deform several areas of the pressure hull in way of the maneuvering room, no damage was sustained by the control cubicle.

[1] See briefs of damage in Appendix I for these two subsequent actions.