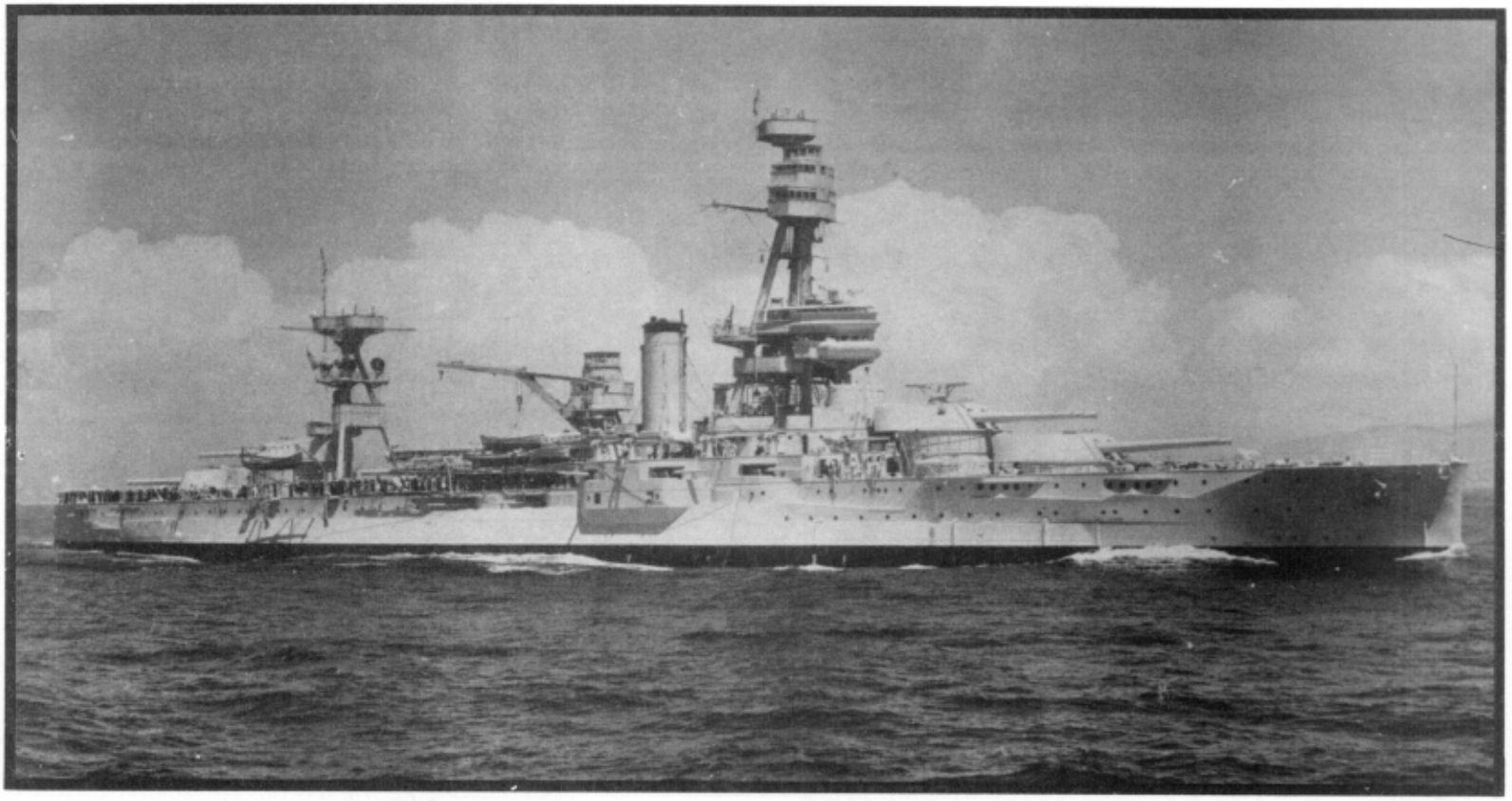
National Historic
Mechanical Engineering
Landmark

Reciprocating Steam Engines
U.S.S. Texas



Houston, Texas December 1, 1975

The Battleship Texas Commission, State of Texas
The American Society of Mechanical Engineers

Commissioned by
The United States Navy

Built by
The Newport News Shipbuilding
and Dry Dock Company

INTRODUCTION

The U.S.S. Texas is the last surviving warship of its kind--powered by reciprocating steam engines. It was built during a period in which naval authorities were switching to the newly-developed steam turbine for propulsion, but were unsure of its suitability. Only one more warship, the New York, commissioned one month after the Texas, was to be powered by the reciprocating engines.

Such was the state of the art at the time that the Texas[1] engines were described as "the ultimate in naval reciprocating engine construction." They could be rightfully described in these glowing terms, as was shown by their dependable service from 1914 until after World War II, when the Texas was removed from the Navy's active roster.

For these reasons, the U.S.S. Texas, with its reciprocating steam engines, has been declared a National Historic Mechanical Engineering Landmark.

The Texas in 1944. Navy Dept. Photo

STEAM POWER, WARSHIPS, AND THE U.S.S. TEXAS

In a world swept by the Industrial Age, it is surprising to note that the steam engine--perhaps the quintessence of those times--was not considered acceptable power for capitol ships by naval authorities until the late 1870's. Although by 1850, fully one quarter of all naval ships were steam powered, they were small ships and auxiliary craft; the man-o-war was still sail powered. Because of the maneuverability of steam-powered craft regardless of wind, however, they were regarded as highly valuable for positioning large warships during engagements. The British Navy operated in this manner during naval engagements of the Crimean War (1853-56).

Although steam's advantages in battle were recognized and exploited, the big warships were still sail powered. In as late as 1860, the English Seamanship Manual, official training textbook for British naval officers, carried the following passage: "Engines and machinery, liable to many accidents, may fail at any moment and there is no greater fallacy than to suppose that ships can be navigated on long voyages without masts and sails." This prevalent view held by the navies of the industrial world at that time was not groundless. Propelling machinery was still excessively heavy and bulky, and consumed enormous amounts of fuel. Coupled with these factors was a power-weight ratio of about one ton per horsepower (the propelling machinery of post-World War II battleships weighed less than 50 pounds per horsepower).

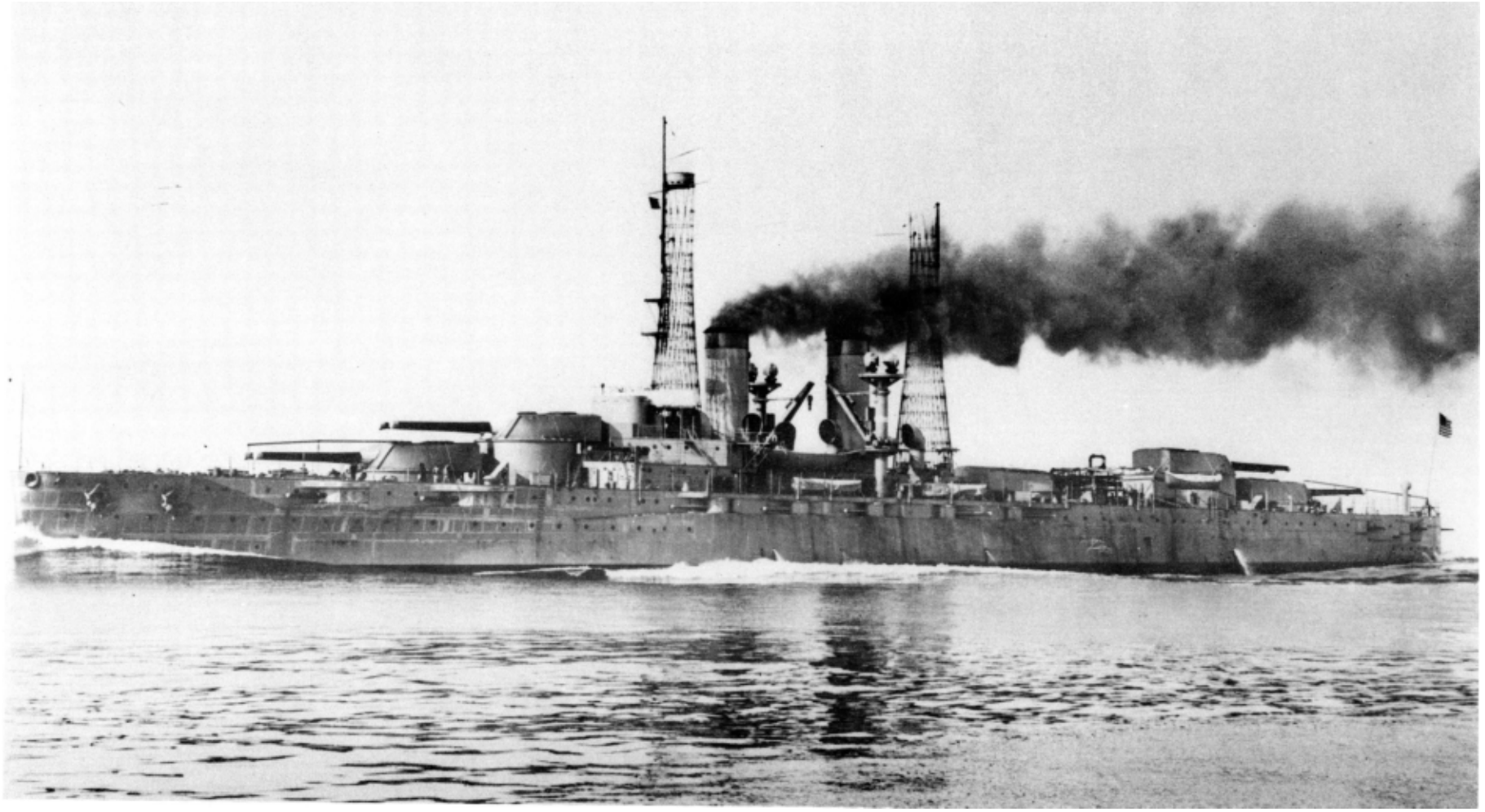
Technical improvements in the 1870's relieved steam of most of its deficiencies, however, and by the 1880's sail power had been relegated to an auxiliary role, or had been done away with, on warships then under construction.

Steam power in U.S. warships then underwent a rapid evolution. The Navy, slow to change to steam, adopted the steam turbine quickly. By the time the construction of the U.S.S. Texas was authorized in January 1910, the Navy already had three turbine-powered battleships.

Why, then, was the Texas built with reciprocating steam engines? According to Jane's Fighting Ships, 1943-44, "Builders of turbine engines in the U.S. refused to adopt standards laid down by the Navy Dept. Accordingly in these ships * a reversion was made to reciprocating engines to show turbine builders that the Navy Dept. was determined to have turbines built to official specification, or else the older type of engines would be taken up again." At the time, too, the reciprocating engine had proven to be more fuel-efficient than the direct-drive turbine, especially at cruising speeds.

For these reasons the sister ships Texas and New York were built with the last, and most sophisticated, reciprocating steam engines. The Oklahoma, also designated to be built with these engines, ended up turbine-powered.

*The Texas, the New York, and the Oklahoma.



The Texas on its trial runs in 1913. The radically different appeara:nce of the ship on the cover is due to a major conversion in 1925. At that time, the Texas was converted to an oil-fired ship, “blisters” were added to the hull armor for torpedo protection (this increased the ship’s beam by about 12 feet), and the higher, more modern superstructure was added.

-U.S. Bureau of Ships Photo

THE TEXAS' RECIPROCATING STEAM ENGINES

The Texas was propelled by twin screws driven by 4-cylinder triple-expansion engines having a total designed horsepower of 28, 100 at 125 revolutions per minute, with steam at 265 pounds per square inch. Cylinder bores were: High Pressure, 39 inches; Intermediate Pressure, 63 inches; and two low pressure 83 inch cylinders, all with a 48-inch stroke. Cylinder sequence was: Forward Low Pressure, High Pressure, Intermediate Pressure, Aft Low Pressure, The crank angles were 90 degrees, and the working sequence was: High, Intermediate, Forward Low, Aft Low. Piston valves were used on all cylinders, one for the high pressure cylinder, and two for each of the others, actuated by Stephenson's double-link valve gear.

The bedplates were cast steel and the framing Navy-type forged steel columns bolted to the bedplate and cylinders, braced by diagonal, cross, and longitudinal stays. The cylinders and valve chests were cast iron, the working liners being close-grained cast iron. All cylinders except the high pressure were steam-jacketed around the liners and at both ends. The conical pistons were cast steel, except the high pressure, which was cast iron.

All working and moving parts of the main engines, except the valve links and valve-stem guides, were force-lubricated under a pressure of about 50 pounds per square inch. The crank pits were totally enclosed by galvanized sheet-steel casings up to within 18 inches of the bottoms of the cylinders.

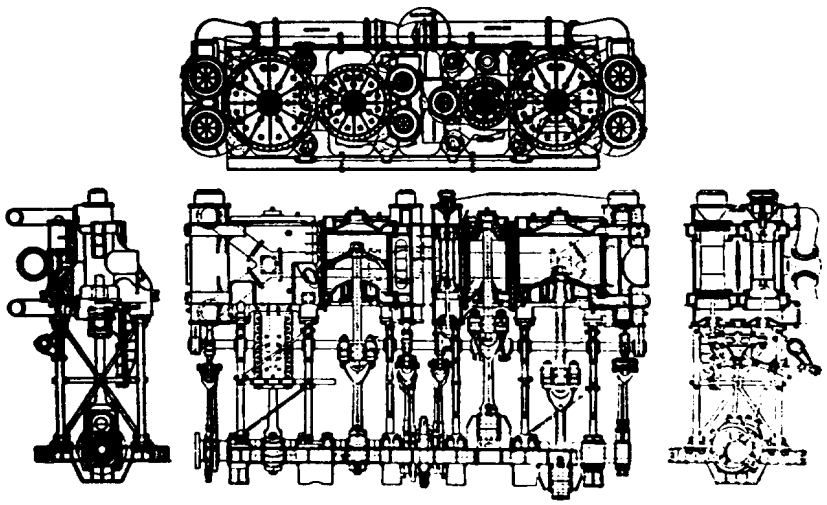


Diagram of a triple-expansion reciprocating steam engine comparable to those of the U.S.S. Texas

Steam for the Texas engines was supplied by 14 Babcock & Wilcox water-tube boilers working at 295 pounds per square inch, trottled down to 265 psi at the engines. The heating surface was 62,213 square feet and the grate area 1,554 square feet. The furnaces operated under closed fire-room forced draft, with an ashpit pressure of 2 inches of water.

Total machinery weight was 2,375 tons and the coal capacity was 2,850 tons. 124 tons of oil were carried as an auxiliary fuel supply.

The propellers were 3-bladed, built-up, with manganese bronze blades. Their diameter was 18 feet, 7 1/4 inches, and their pitch was 19 feet, 11 1/2 inches. When the ship was moving forward, the propeller shafts turned outward.

Having described the mammoth engines' specifications, a description of reciprocating engines in operation, drawn from The Man-of-War, would be appropriate: "The scene in the engine room of a pre-Dreadnought* battleship at speed was like an inferno. As the great piston rods leapt wildly up and down and the connecting rods whirled the massive cranks round, hot oil and water spurted everywhere. Seawater from hoses playing on hot bearings sloshed in the bilges. In an atmosphere murky with steam from dozens of small leaks, the engine officers would stand on the greasy deck plates, oilskins buttoned to the neck, their faces black and their clothes soaked in oil and water. All over would be a noise so deafening that telephones could not be used. Breakdowns from overheated bearings or broken steam joints were common, and were always expected. After any prolonged period of high-speed running there would be work for the dockyard engineers."

Although this may be an exaggeration of what went on in the Texas, it is representative of the state of the art before the turbine came into use.

*The H.M.S. Dreadnought was the first turbine-powered battleship, built in 1906.

GENERAL SHIP INFORMATlON

The U.S.S. Texas, one of the last U.S. Navy battleships powered by reciprocating steam engines, was built by the Newport News Shipbuilding and Dry Dock Company at a bid price of $5,830,000. The keel was laid on April 17, 1911, and the ship was launched on May 12, 1912. The Texas left the Newport News yard and was commissioned on March 12, 1914.

The ship is 573 feet long, had a beam of 94 feet, 9 inches, and a displacement of 27,000 tons. Its 28,000 horsepower reciprocating engines could drive it at a speed of 21 knots. It carried 1,314 crew members.

The Texas mounted ten 14" guns, sixteen 5" guns, eight 3" guns, and 40mm anit-aircraft guns. It also carried 3 recoverable seaplanes which were launched by a steam catapult on the stern. The ship's hull had 12" belt armor, the gun turrets 14" armor plate, and the conning tower had 12" armor plate.

THE TEXAS AND TWO WORLD WARS

Although the Texas was newer at the time, it saw more action in World War II than in World War I because of the vastly different characterisitcs of the two wars. During World War I, the Texas served in the Atlantic and was present at Scapa Flow for the surrender of the German Fleet.

From Pearl Harbor until October 1942, the Texas was on Atlantic duty. In October, it sailed for northAfrica, taking part in pre-invasion bombardments. The ship returned to the U.S. in November, 1942, and served in the north Atlantic on convoy escort duty until February 1944, when it was fitted as the flagship of a group of warships under rear admiral C. F. Bryant, U.S.N.

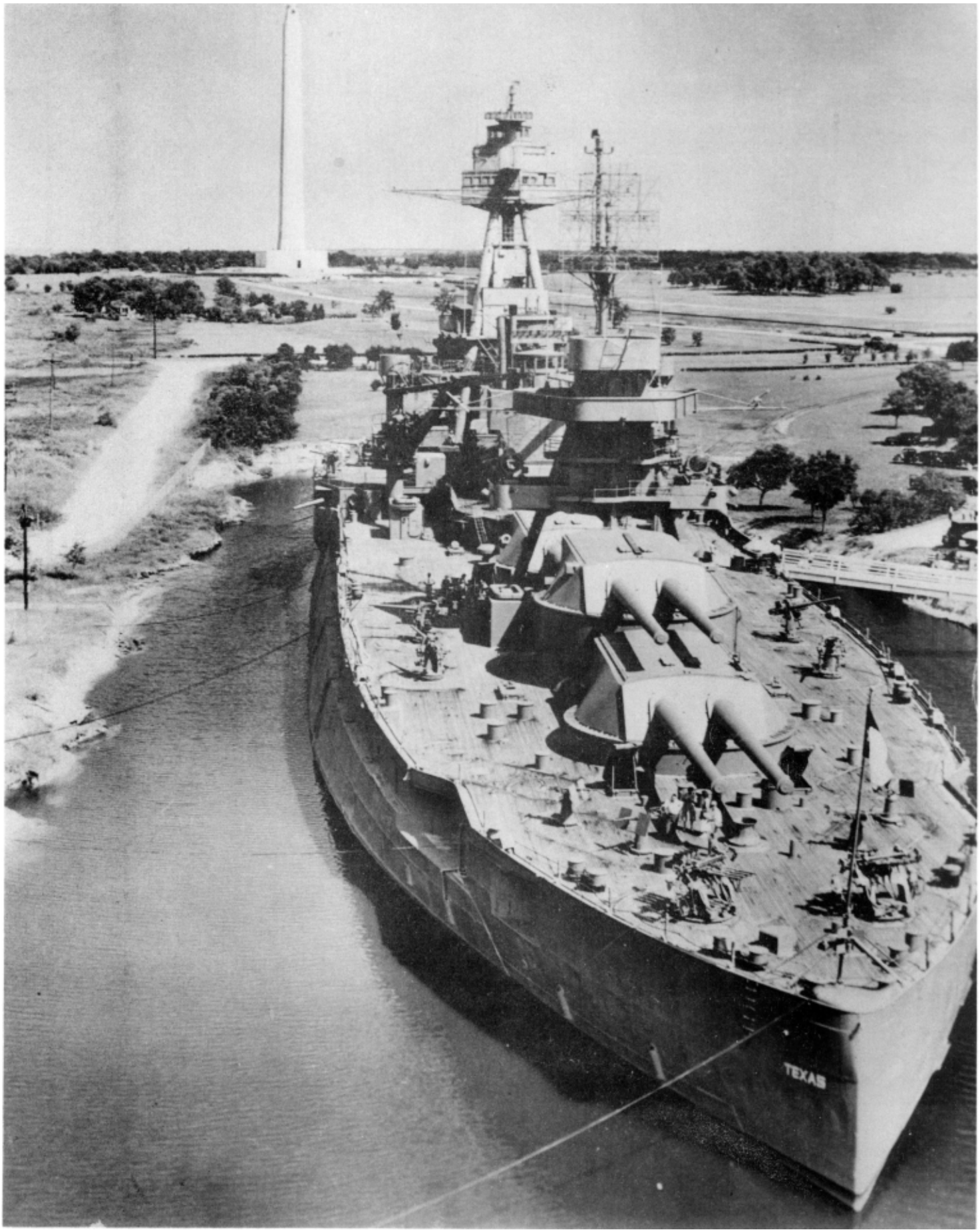
The Texas, under Bryant, fired the opening naval salvo of the D-Day invasion at Normandy. According to Warships of the World, the Texas took a position within 12,000 yards of the coast (the closest of any battleship), and, at 5:50 AM on June 6, 1944, commenced main and secondary battery bombardment of German coastal batteries. Throughout the invasion, the Texas provided support of Allied forces. On June 9, while bombarding the French coast, the Texas' guns demolished the railroad station at Isigny, several miles inland, and scattered a German convoy in the area. The Texas was also in the Mediterranean, taking part in the bombardment of St. Tropez on August 16, 1944.

With the Atlantic war wound down, the Texas moved to the Pacific, where it took part in the months-long naval bombardment of Iwo Jima prior to the famed invasion.

THE TEXAS AS A MONUMENT

On San Jacinto Day, April 21, in 1948, the Texas was decommissioned, presénted to the State of Texas, then recommissioned as the flagship of the Texas Navy. The ship was a gift, authorized by the U.S. Congress, to the state, and a special commission was established by the Texas Legislature to provide a permanent berth for the ship and to raise funds for its maintenance. Funds to save the ship from the scrap heap were raised in a campaign conducted by Mr. Lloyd Gregory, the first chairman of the Battleship Texas Commission. During the fund-raising campaign, schoolchildren from all over the state were asked to contribute nickels and dimes to help save the ship. Interest among the young continues to this day: earlier this year, a flag was presented to the ship by a second grade class in the Houston area.

The Texas had many "firsts" in battle, and in its retirement it achieved another first, being the first ship named after a state to return to that state as a monument. Today, moored in a slip dredged for her at the edge of the San Jacinto Battleground State Park, the Texas is a museum and a popular attraction visited by thousands each year. In the background is the 570-foot San Jacinto Monument. At its base is a museum of Texas and regional history.



Permanently berthed today, near the San Jacinto Battleground Monument (rear).