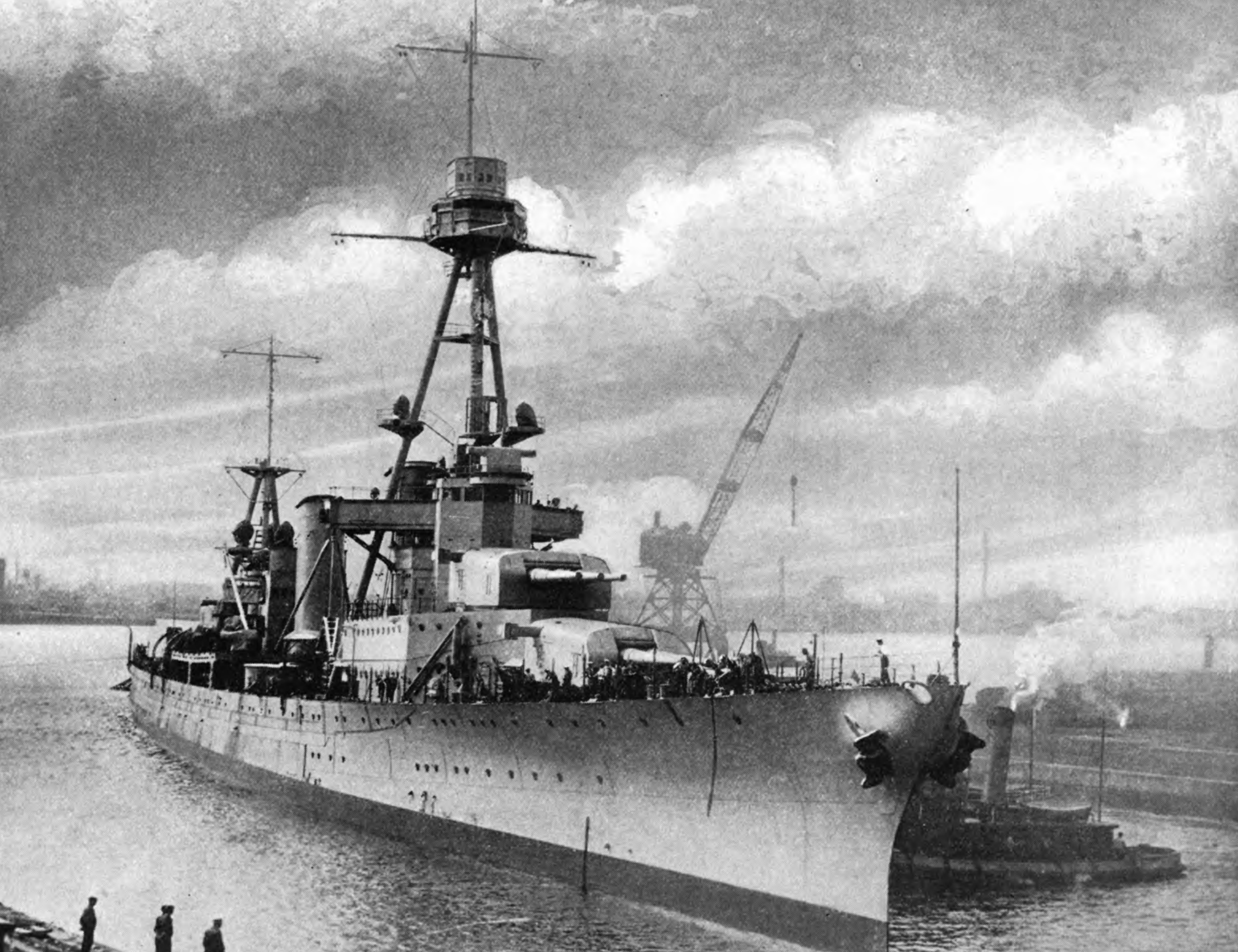
Part IV:
The War Years



Part IV:

The War Years

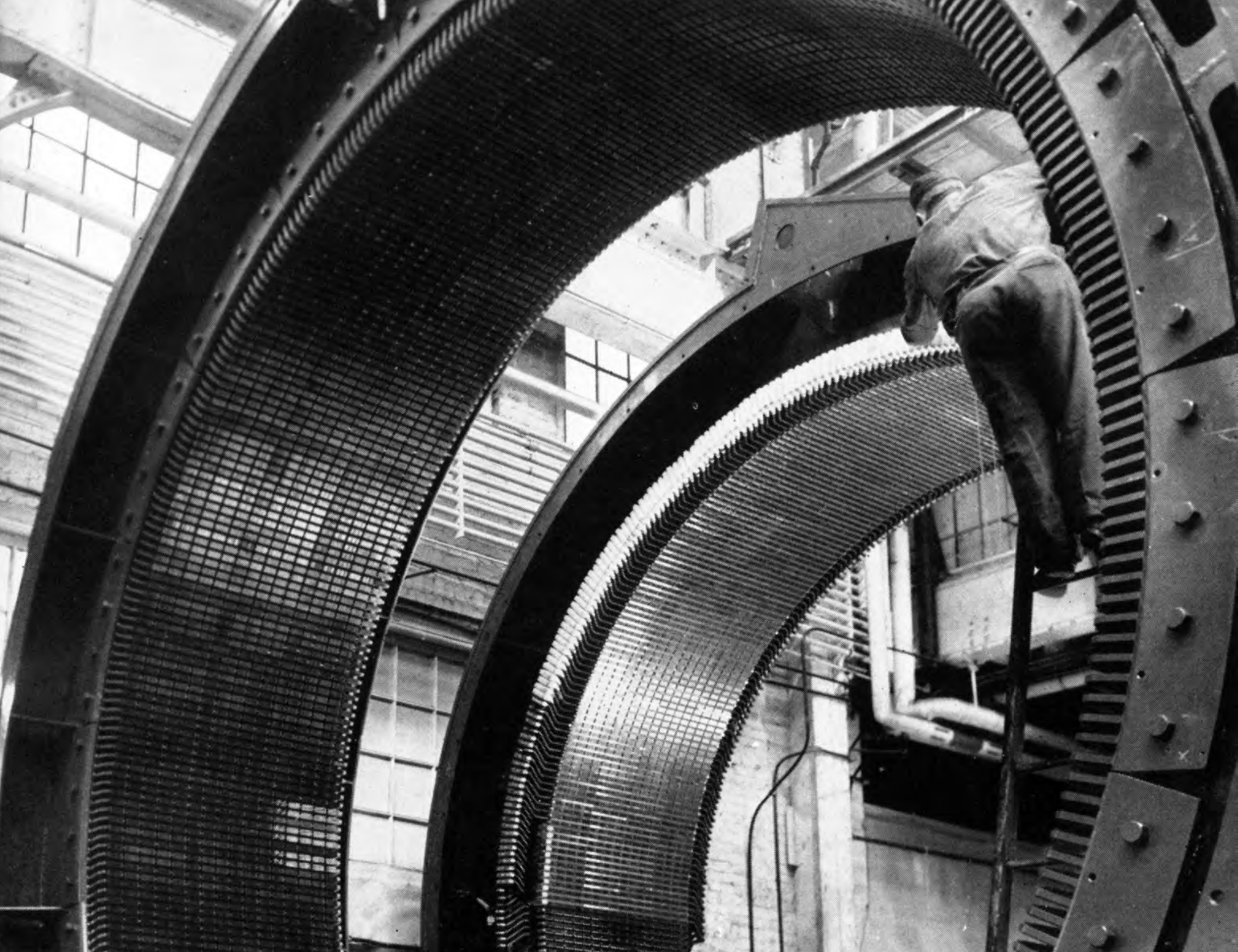
World War II was the largest and most violent armed conflict in the history of mankind. Between 1939 and 1945, most of the world's nations were affected by a struggle that saw over 100 million people under arms and more than 70 million people killed. When peace was restored, the political and economic landscape of the world had been radically altered.

To a large degree, the outcome of the war was decided not by force of arms but by industrial production. During the war years, the United States greatly out produced all of its allies and all of its enemies. At its output peak, U.S. manufacturing almost equaled that of all of other combatants together. Between 1939 and 1944, the United States Gross National Product increased by more than 60%, and industrial output tripled.

These accomplishments are all the more remarkable because they occurred with little effective advanced planning and primarily in reaction to the outbreak of war. Despite ominous and growing threats in Europe, Africa and Asia during the 1930s, and even as Europe, and then Asia, exploded into war at the end of the decade, there was no agreement among the American people or its leaders on what stance the United States should adopt to address these issues. Protected by two broad oceans, many Americans were convinced that the United States did not need to get involved in the conflicts. None of the major combatants were less prepared for war than the United States in 1939. It wasn't until the surprise attack on Pearl Harbor in December 1941 that American opinion unified around industrial mobilization and all out commitment to war.

Despite an absence of public support, the U.S. military, President Roosevelt and Congress did take early, preliminary steps to prepare the country to fight. Although wide-ranging industrial mobilization was politically impossible, the government began to loosen its purse strings. Appropriations came faster than the War Department could absorb them. An initial allocation of a half billion dollars in 1939 ballooned to more than $8 billion in 1940 and $26 billion in 1941. By the time of Pearl Harbor, Congress had allocated more for military procurement than it had during all of World War I.

With the U.S. at war, the government assumed significant control of industrial production through the Office of Production Management and the War Production Board. For American manufacturers, a flood of military contracts enabled them to shake off almost overnight the remaining affects of the Great Depression. Profits remained thin, but the factories were full and unemployment was nearly eliminated. By the end of the war, American industry was operating at high efficiency and prepared to produce the goods needed to rebuild the world.



Submarine motors

Elliott Company's 1934 annual letter to shareholders was the first written by Fred Elliott as President. He noted:

> "The volume of business in 1934 was almost twice as large as that in 1933, the principal item of increase being the acceptance by your company of work under contract for the Navy Department in respect to electrical equipment for submarines."

Since 1917, prior to its acquisition by Elliott, Ridgway had built submarine propulsion systems for the U.S. Navy, including enclosed, air-cooled forced-ventilated motors and diesel-electric drives on propellers. The submarine propulsion programs at Ridgway and Elliott were managed for more than 20 years by I.S. Nippes, Manager of Naval & Railway Engineering, who was known within the company as "Mr. Submarine."

Early submarines were generally restricted to near-shore, coastal operations. After World War I the navies of all of the major powers began to develop fleet type submarines – larger, faster vessels with extended range, capable of cruising with a surface fleet. A fundamental challenge in the design of these boats was to create high-speed motors that were light and compact enough to fit within the cramped, tubular hull.

In the early 1930s, the U.S. Navy turned to Elliott to produce an advanced, high-speed submarine propulsion system. Elliott built the Navy's first high-speed diesel-electric drives and the first geared motors employing multiple diesel-electric drives. Both of these systems were more complex than those they replaced. Ridgway helped to train the Navy's engineering officers and chief electricians on the assembly, disassembly, operation and maintenance of the new propulsion machinery.

With the U.S. entry into the war, much of Ridgway's capacity was devoted to supplying electric propulsion machinery for the quickly growing submarine fleet. These production demands led Elliott to discontinue the manufacture of steam engines at Ridgway in 1941 and to focus solely on building electrical apparatus there. By the end of the war, Elliott had built diesel-electric drives for scores of U.S. submarines. As the war progressed, the development of sonar exposed submarines to an increased threat of detection – geared motors were noisy. The Navy selected Elliott to build a direct-connected, slow-speed motor that was nearly silent. Toward the end of the war, the Navy used this new drive to replace noisier geared motors.

Speed was critical for all sorts of vessels during the war in order to engage or elude adversaries, and to more quickly deliver critical materiel. This was especially true for oil tankers with their vital cargoes. The Elliott factories at Ridgway and Jeannette equipped a number of new high-speed tankers with 6,600-hp main propulsion motors and auxiliary turbine-generators. Drawing upon its expertise in producing marine propulsion systems, Elliott also equipped ore freighters operating on the Great Lakes with geared turbine drives and Coast Guard vessels patrolling the United States' home waters with diesel-electric motors.

Wartime production

With the prospect of war on the horizon, in the later 1930s the US Navy began to construct a number of new warships. In August 1937, the keel of the USS North Carolina was laid at the New York Naval Shipyard. The North Carolina and her sister ship, the USS Washington were the first American battleships built since World War I. The Brooklyn Navy Yard designed the ships with the most advanced technology available, including high-pressure boilers and turbines producing over 120,000 HP. The four engine rooms each had two boilers and one steam turbine connected to one of the four propeller shafts. The Navy's design included four deaerating feed tanks, one in each engine room. The deaerating feed tanks in Navy ships had to operate without interruption, even when the ships pitched and rolled in the roughest seas. The Navy selected Elliott to supply the deaerators for the North Carolina and the Washington. These were likely the first deaerators installed in US Navy capital ships.

By 1940, Elliott's business was looking up. Employment had increased 10% to 1,200, and the year ended with the largest backlog of orders in company history. Many orders were from the U.S. government in connection with the National Defense Program. The next year, in 1941, shipments were the highest in the company's history, and the backlog was 60% higher than the record set the year before. In his 1941 letter to shareholders, Howard Hubbard noted, "These abnormal conditions have been caused by the war program. This volume of business will require the Company's plants to operate at a very high level throughout 1942."

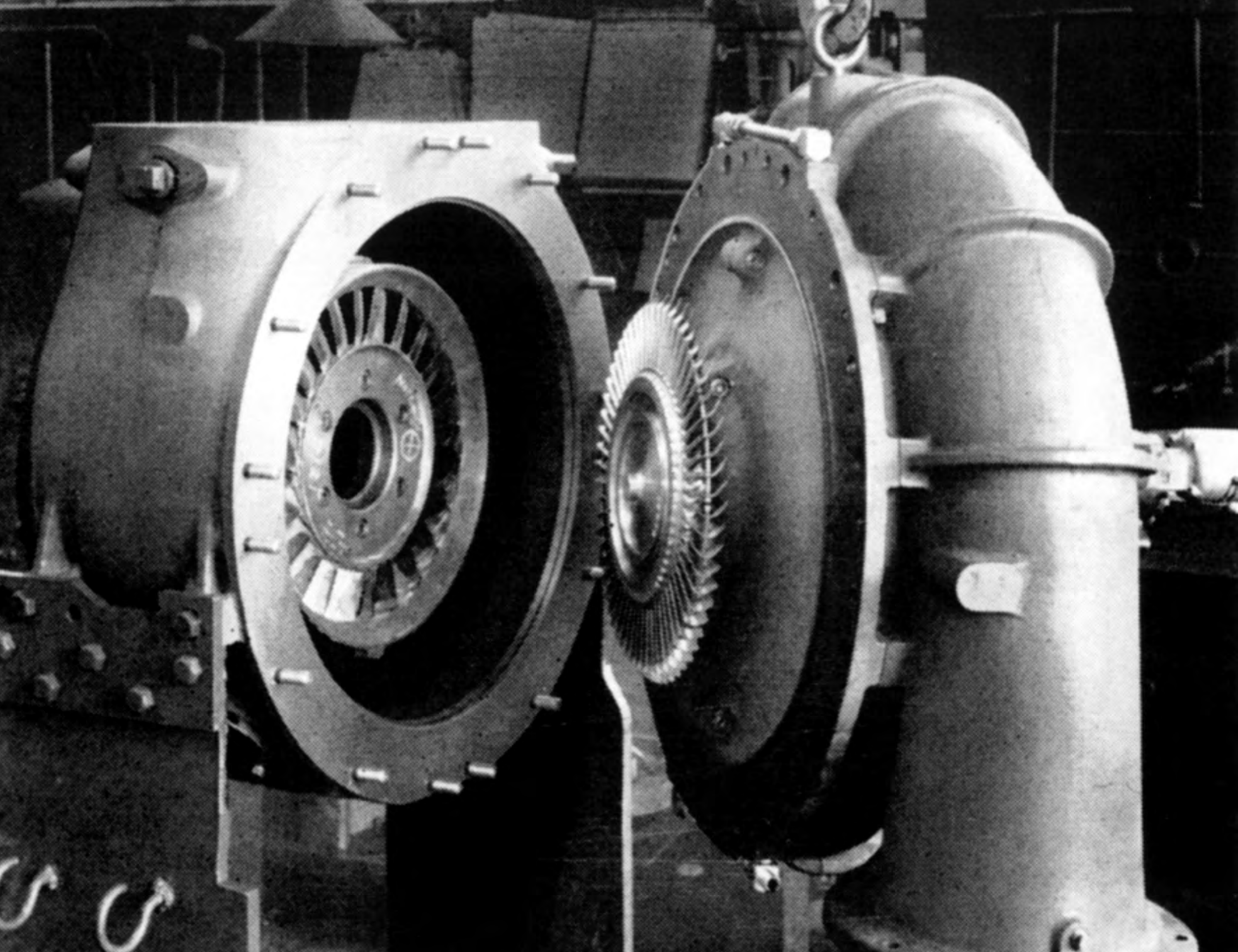
After the United States entered the war in December 1941, construction of warships accelerated to flank speed, and the U.S. Navy turned to several naval design firms to help with the expansion. Gibbs & Cox, designers of the famous Liberty ships, also had the design contract for destroyers. Elliott supplied deaerating feed tanks for many of the destroyers designed by Gibbs & Cox, and for several heavy cruisers, battleships and aircraft carriers. All of this equipment was built in Jeannette.

Elliott also supplied its industrial customers with equipment that was vitally important in the overall war effort. Elliott steam jet ejectors were used to "freeze dry" blood plasma so that it could be stored and transported to distant battlefields. The company's full array of turbines, generators, condensers, ejectors, deaerators, strainers, blowers and tools was shipped to power plants, factories and refineries running at full capacity to provide the materials of war. The Lagonda Division in Springfield supplied the tube cleaning equipment needed by the petroleum industry to produce gasoline and synthetic rubber. To enable Elliott to meet the government's urgent requirements, in 1942 the Navy Department provided Elliott with additional manufacturing equipment. Elliott rented the tools with the option to buy them later at depreciated prices.

Shipments, bookings and employment continued to set new records. The Jeannette and Ridgway plants both won the coveted Army-Navy Production Award, the "E" award, for exceptional performance in supplying war materiel for America's fighting forces. When presenting the award, Rear Admiral W.C. Watts, U.S.N. (Ret.) cited Elliott for "nearly tripling your working force in the past three years and stepping up your output to five times its earlier volume." Employment in 1943 actually declined slightly due to transfers to the armed services, but the reduction was made up in part by the "training of relatively inexperienced applicants not previously identified with war work."

The extraordinary pace of expansion created a host of problems for Elliott's management. Even with the Navy's loan of production machinery, Elliott was stretched thin. Money was needed to finance the war production contracts. Early in 1943, Grant Shipley joined Elliott as Chairman of the Board, and he soon replaced Howard Hubbard as President. In August 1943, Elliott obtained a $7 million "V-Loan." The loan helped Elliott to meet its obligations, but the company still needed working capital.

The production tempo established in 1943 continued into 1944. The increasingly urgent need for capital led Elliott to offer 50,000 shares to the public. The stock was listed on the New York Curb Exchange, which in 1953 became the American Stock Exchange. By the end of 1944, the number of Elliott Company shareholders had grown to 1,700, scattered throughout 40 states. This initial public offering presaged the end of Elliott as a family-controlled company.



New products

While Elliott Company was manufacturing equipment as quickly as possible, it also continued to expand its product line. The most significant development of this period occurred in 1940, when Elliott obtained the first U.S. license to manufacture Büchi turbochargers for diesel engines. Dr. Alfred J. Büchi, a Swiss engineer, developed the first exhaust-driven turbocharger between 1909 and 1912, while head of the Sulzer Brothers Research Department. Büchi's design was elegantly simple. Engine exhaust gas powered a small turbine. The turbine in turn drove a compressor, which supplied compressed air for engine combustion, boosting engine efficiency and horsepower. By 1915 Büchi had a prototype of a turbocharged diesel engine, but his ideas gained little acceptance until two German ships fitted with 2,000 HP turbocharged diesel engines were launched in 1925.

In 1941, Elliott manufactured and installed the first turbocharger on a diesel engine in the United States. The technology, combining a turbine and a compressor on a single shaft, was familiar to Elliott. The turbocharger business grew quickly during the war. The advantages of boosting the power of engines in trucks, armored vehicles and the confined spaces of ships was quickly apparent to the War Department.

Elliott added to its tools business with the March 1944 acquisition of the Roto Company of Newark, New Jersey. The Roto Company supplied tube cleaning equipment to shipyards and factories along the east coast.

A significant internal development project during the war was a gas turbine originally designed for use in ship propulsion. Several hundred engineers from a wide range of industries came to Jeannette in the summer of 1945 to observe the successful test of the prototype. The event was covered by publications including The Wall Street Journal, Business Week, Newsweek, Oil & Gas Journal and Power. This was the first successful marine gas turbine ever built. It immediately attracted considerable attention from many potential users. Grant Shipley wrote that, "A bright future is foreseen for power generation by gas turbines in the marine, land power, chemical processing, and locomotive fields. We plan to maintain leadership in these positions." Despite the project's initial promise, development of the turbine was abandoned by 1950, due to what were then insurmountable metallurgical difficulties associated with the high operating temperatures.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Transition to peace

1945 saw the end of the war. Many government contracts were immediately canceled. The most significant cancellation for Elliott was the termination of the submarine propulsion work at Ridgway. Other operations continued at a relatively high level through the year, although employment fell to 2,700 from a high of 3,500 the year before.

The end of the war found Elliott Company in good shape. At the annual meeting in March 1945, Grant Shipley turned over the position of President to William A. Elliott, although Mr. Shipley remained Chairman of the Board. The company had been profitable each year since 1939, and it had sufficient working capital. Its four factories – in Jeannette and Ridgway, Pennsylvania; Springfield, Ohio; and Newark, New Jersey – had been expanded and improved during the hectic years of war. The company staffed twenty sales offices throughout the United States. Product research and development was producing advances in engineering and manufacturing. The turbine line had been extended up to 12,500 kW. Turbochargers and deaerators had been redesigned, and the entire electrical line in Ridgway was being upgraded. The successful test of the marine gas turbine had resulted in more inquiries than Elliott could then handle.

Looking ahead, Grant Shipley wrote:

> "Competition in the post-war period no doubt will be extremely severe and some companies may fall by the wayside. We are certain to encounter additional competition from companies that have been drawn into our product fields during the war. The going will be tough, but with continued team play and hard work we can, and will survive and grow."