Record Marine Engine
Construction by Hendy

● Methods Developed to Produce 546 Reciprocating Steam Propelling Engines at Fastest Speed Ever Known. Over 400 Already Finished

IN the report of the Senate Subcommittee on Naval Affairs on private shipbuilding companies of the Pacific Coast, appears the following remark:

"West Coast shipbuilders found early in the program that serious delays and an almost impossible work-planning situation was created by the spasmodic arrival, or sometimes complete failure to arrive, of certain engines ordered from Eastern manufacturers. The Joshua Hendy Iron Works Co. of Sunnyvale, Calif., a comparatively small organization, sought permission to make these engines in the immediate vicinity. Once permission was obtained and production started, this company performed an outstanding job, and delay due to failure of engines to arrive when needed was eliminated."

While the foregoing is highly significant there is more in the statement than meets the eye, for this plant, which was of but modest size when the Japanese raided Pearl Harbor, is now the most extensive producer of marine reciprocating engines on the Pacific Coast—in fact in the entire country, if not in the world! The growth of the Hendy works in a remarkably short space of time has been phenomenal. By the end of 1943 no less than 8,500,000 tons of cargo ships will have gone to sea with Hendy steam engines and turbines, apart from a number of destroyer-escorts.

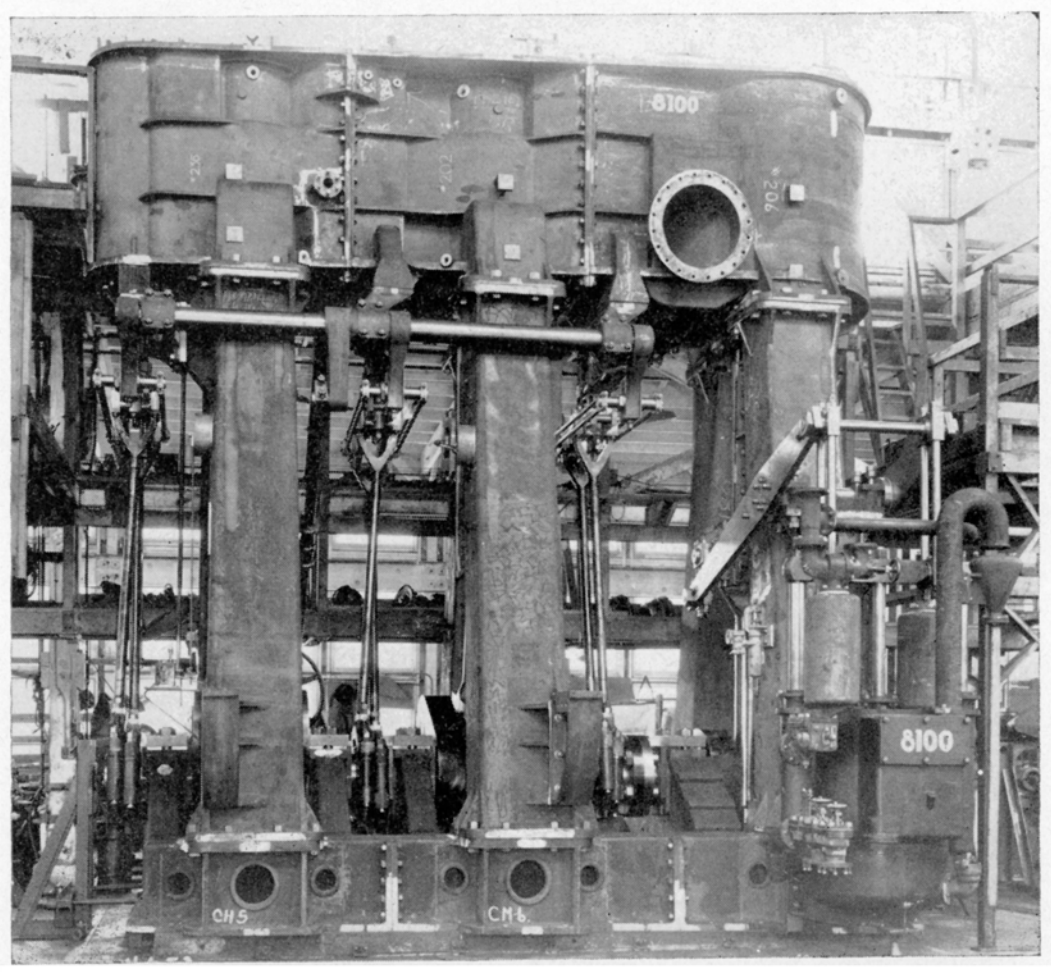
Before discussing the rapid wartime growth of the Hendy plant we will delve somewhat into the company's history, for this concern was building marine steam engines during the last war, and completed enough for 100,000 tons of freighters, although it took 25 months to do what the company is now accomplishing in 11 days, despite the fact that the engines are of the same general type. More than three-quarters of a century old, the story of the Joshua Hendy Iron Works is interesting. Joshua Hendy, a New England machinery man, caught the Western fever in the gold rush days of 1848 and went to San Francisco, where he started a business supplying mining machinery. This branch of engineering proved profitable and the business grew steadily. With the company officially established in 1856 Hendy had his nephews join him, and in the following 50 years they adjusted their business from time to time in accordance with the changing conditions, manufacturing everything from hydraulic equipment for placer

THE MAN BEHIND THE ENGINE—Charles F. Moore, president, Joshua Hendy Iron Works, Sunnyvale, Calif., which has made over 400 Liberty engines for the war effort, plus many geared turbines, special naval equipment, and Corvette engines.

BAY OF ONE OF THE MACHINE SHOPS at the Hendy plant. Note the slogan on the crane. The plant—already about five times its prewar size—is constantly being expanded.

JOSHUA HENDY IRON WORKS
SAN FRANCISCO CAL. U S A

THE WAR YEARS



OVER 400 of these 2,500 hp. reciprocating steam engines for Liberty ships have been manufactured and delivered to shipyards by the Hendy plant since November, 1940.

mining to horse-drawn fire engines, including considerable export work.

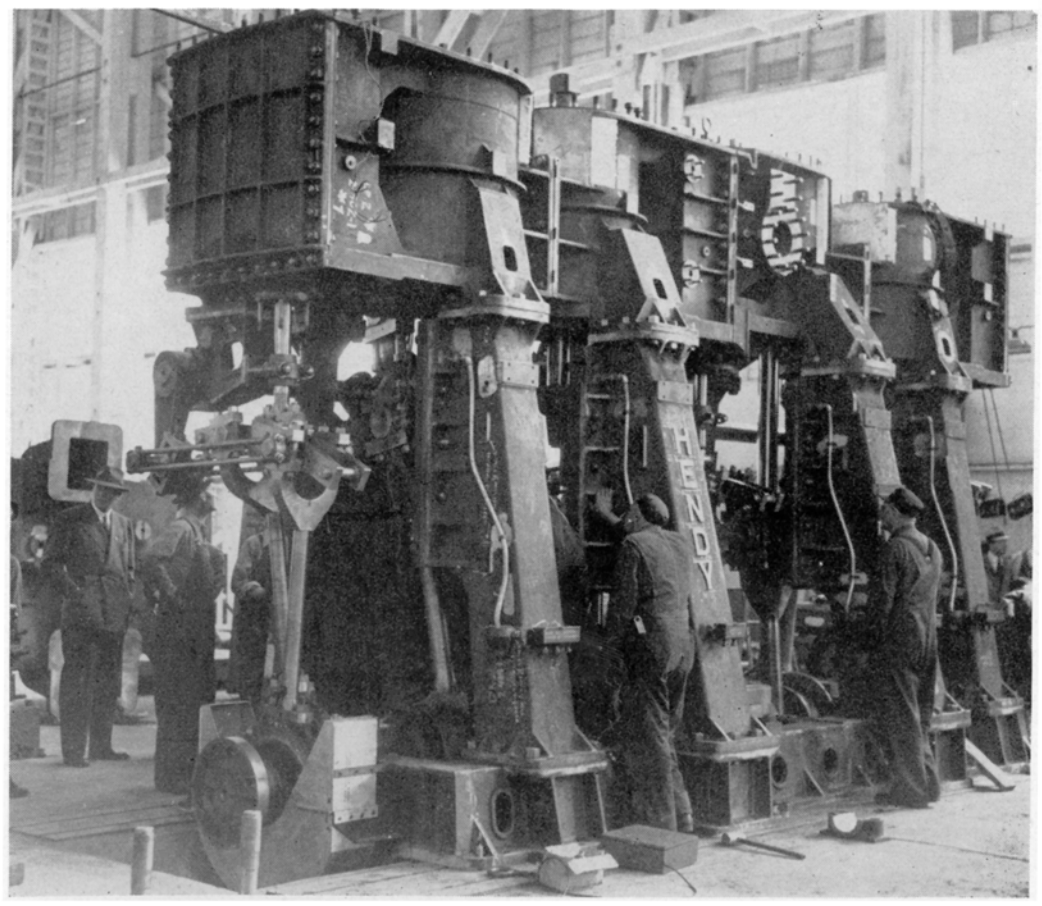
The great San Francisco fire destroyed their plant, and a new plant was erected at Sunnyvale, about 35 miles from the Golden Gate city. Manufacture of mining equipment continued with the addition of irrigation equipment and machine tool job work. Then came World War I, when the capacity of the plant was turned over to the construction of marine steam engines. But the real development of the Hendy plant came with World War II. In November, 1940, Charles E. Moore, machine tool marketer, and associates acquired the business, and in the space of one year lifted it from the class of a virtually inactive factory to its present status of being the largest producer of marine reciprocating engines, plus turbines and special equipment for the Navy. In view of the scarcity of machine tools and skilled mechanics the rapid rise of Hendy is almost unbelievable.

The initial order was for 12 Liberty ship engines from the Maritime Commission; but very soon Washington asked Mr. Moore to take 24 additional engines; but he suggested that while they were about it why not increase the contract to 100 units. Orders were to go ahead, and that rate of increase in orders occurred until a total of 546 were placed. This was followed with a contract for reciprocating steam engines, somewhat smaller in overall size, but of higher revolutions, for destroyer-escort ships which are now being completed as fast as Liberty ship engines. Prior to this the Hendy concern entered into arrangements with the Maritime Commission to also build marine turbines. A large number of these of 4,000 hp. sets are under construction. Production of another series in the 8,000 hp. group is just getting under way. The reduction gears for these turbines are also being manufactured at the Hendy plant.

Upon receipt of the order for the 100 Liberty ship engines, Mr. Moore and his staff buckled down to the great task confronting them, and under a constantly accelerated program of expansion soon began to complete and deliver engines at the rate of one a day. Drawing from his long years' experience on the Pacific Coast supplying machine tools, Mr. Moore was able to gather new machines, rebuild old ones and create special tools for specific jobs such as few engineers would have been able to do under the difficult circumstances. Mr. Moore even managed to locate two huge planers in England and bring them to Sunnyvale. These planers are the largest in the West. Many new buildings have been erected in the peach orchards surrounding the plant, and the number of employees have been increased from but 60 in 1940 to over 6,500 today. These include many women. The LOG, when on a recent tour of inspection, noticed that one woman—a mother of two children—was operating a big overhead crane lifting engine frames, cylinders, etc. She climbed up and down the narrow ladder to her lofty perch like an oldtime steeplejack.

Up to April, 1943, no fewer than 300 Liberty ship engines of 2,500 hp. had been delivered to shipyards building ships for the Maritime Commission, and the production schedule of one per day was being maintained regardless of the work on turbines, destroyer-escort engines and naval work. On one day, recently, four Liberty ship engines, one 2,750 hp. corvette engine, and one 4,000 hp. turbine and reduction gear assem-

HENDY CORVETTE ENGINE is smaller overall and turns at higher revolutions than the Liberty ship engine.



bly were delivered to shipyards. These engines will power about 50,000 tons of ships. The first of the C-1 vessels with Hendy turbines and gears recently completed a shakedown voyage of 22,000 miles. Chief Engineer John J. Valentine of the ship visited the Hendy plant together with Curt Schmuck, his first assistant. According to these marine engineers the turbine set worked perfectly throughout the voyage.

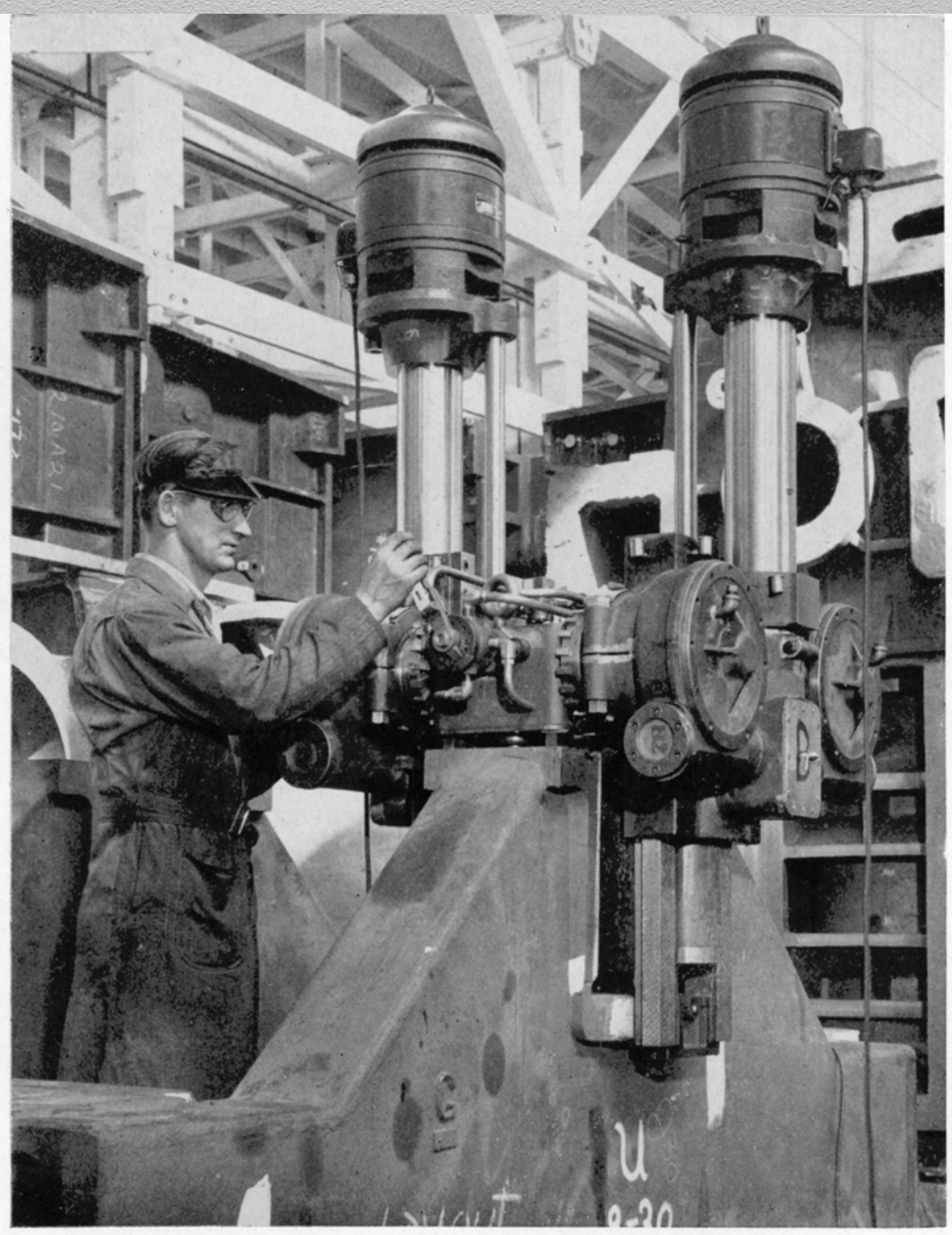
In order to build reciprocating engines in record time the old method of requiring individual parts to be made by skilled workers, each part fitted carefully to the other parts with which they are assembled, had to be abandoned and an entirely new system developed. One of the methods adopted at the Hendy plant has been to use, wherever possible, relatively small machine tools set up for a special operation, with an operator performing one operation only. This plan enables a large number of operators to be trained quickly, and to produce accurate work. Actual setting-up of parts on the tools is done in advance by skilled men who serve half a dozen machine tools in this manner, leaving the operator to do the actual machining only. Higher labor costs of specialists thus come lower than with the old type method.

To utilize all machine tools as much of the time as possible, and so avoid valuable equipment lying idle for periods as is often the case where machining heavy parts are concerned, the layout work, setting up, clamping and aligning are done on "set up plates" before the parts are brought to the tools. These are so arranged that they can be mounted in a fixed position on the machine tool, thus greatly shortening the time from the moment the part reaches the tool to the start of cutting. Consequently, machine tools are stopped only during the short period needed to remove one set up plate with its finished part to put another "already mounted in position" rough part in its place. Sometimes tools are arranged so that the set up plate with the rough casting or forging can be placed alongside the part being machined, the cutting head merely being moved from the finished part to the rough casting or forging.

Jigs, of course, are used throughout all operations to guide the cutting tools to their proper location, and thus insure that all parts are machined without requiring skillful manipulation of the machine tool. Both time and spoilage are saved because the jig—not the operator—guides the cutting tool.

Many of the special machines and equipment which saved hours of time and cost per part are of considerable interest. Some of these are as follows:

Crankshaft Key Seating.—Instead of using a large and costly boring mill to mill the eccentric key seats in finished crankshafts, a new and virtually portable tool was designed which is clamped directly on to the crankpin as is shown in the illustration. Production time was cut from 11 hours down to 4, using a tool costing but $2,500 as against $75,000 formerly, while the operator was trained in two weeks. Direct labor charges are only $4.44 compared with $15.29 under the old system.



INSTEAD OF USING A LARGE planer or milling machine for facing bedplate cheeks, a specially designed tool is located in the main bearing saddle and mills both cheeks absolutely square to gauge dimensions. The entire bedplate is machined in 9 hours instead of 15, and the work is done by an operator trained in four weeks.

SPECIALLY DESIGNED "windmills" milling cutter for machining engine columns. It was developed by Adolph Meyer, a Hendy employee. It turns more slowly than most milling cutters.