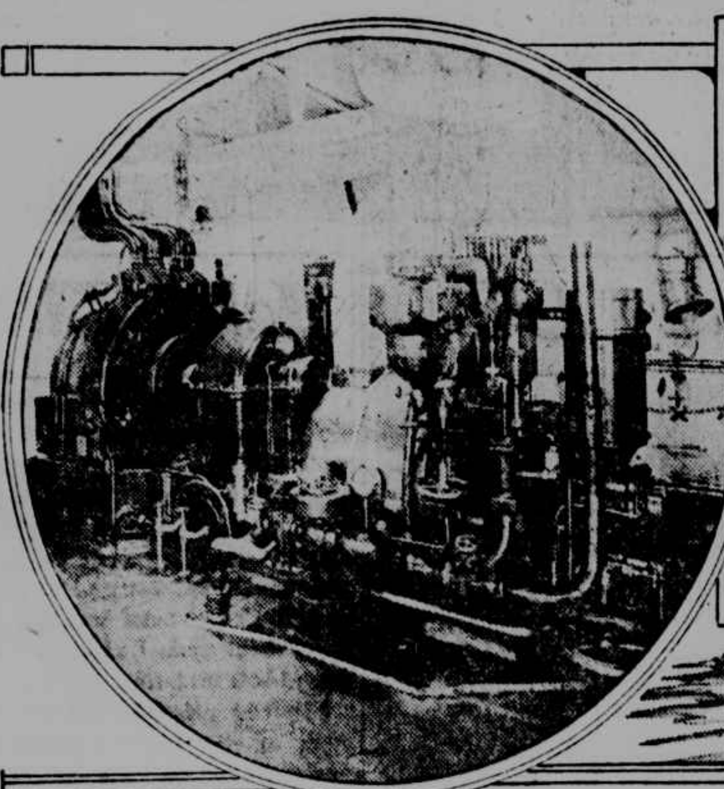
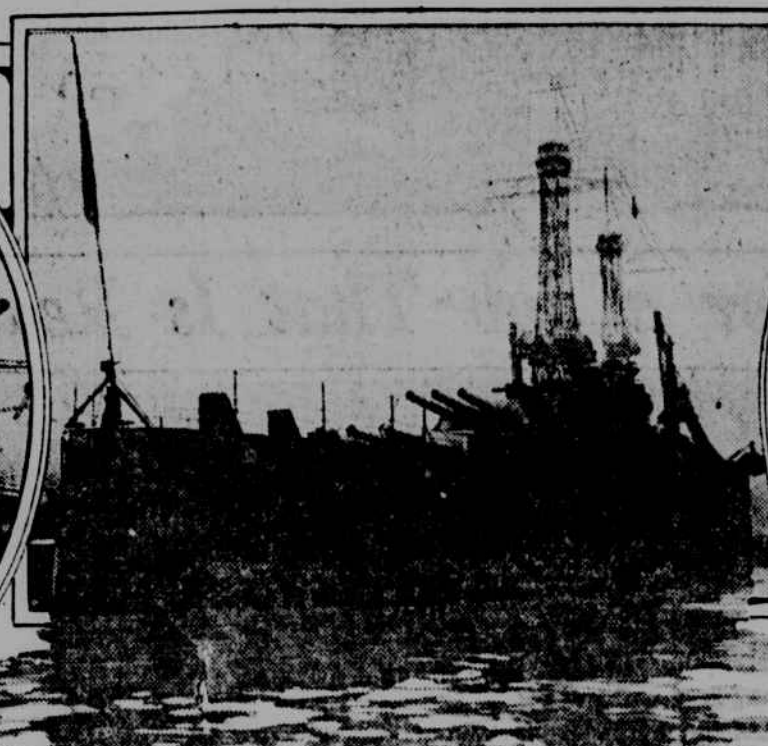
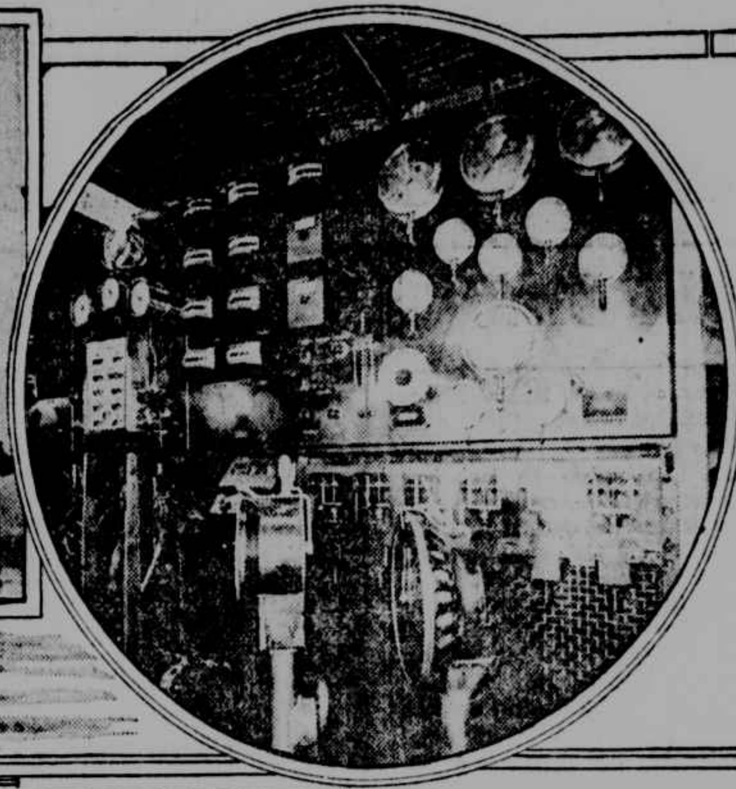
Science and Invention

Aboard the New Mexico, the First Electric Ship



Big turbo-generator unit which furnishes electric current





Main control apparatus and switchboard

The New Mexico afloat and in drydock in the Brooklyn Navy Yard

A VERY great deal has been said and written about the United States battleship New Mexico. Popular interest, no doubt, has centred around this great superdreadnought because it is the first battleship of any nation to be propelled by electricity.

Electric drive has been so successful and its military advantages have become so generally recognized that the Navy Department has decided to equip all of its new capital ships with electric propulsion apparatus.

With a view to presenting to the public an intimate popular description of this battleship, the General Electric Company, which manufactured and installed its electrical propulsion equipment, recently asked and received the permission of the Navy Department to visit the New Mexico at dry dock in the Brooklyn Navy Yard, to mingle with the officers and men and to take pictures of the ship, both inside and out.

The results of this visit are here set forth. The views are believed to be the only pictures of the interior of a battleship ever procured — certainly since the beginning of the European war.

Some Interesting Statistics

Before taking the reader through the ship certain popular and statistical data concerning her will be of interest.

The battleship New Mexico was built at the Brooklyn Navy Yard and launched in the summer of 1917.

She is 624 feet over all.

She weighs (displaces) 32,000 tons.

She draws thirty feet of water.

She is ninety-seven feet four and one-half inches broad, measuring at the waterline.

At full speed she can make slightly in excess of twenty-one knots an hour.

She generates 28,000 horsepower for propulsion.

Her crew numbers nearly 1,200 men.

She burns oil instead of coal as fuel and has a total fuel capacity of 3,400 tons, or 6,800,000 pounds, or about 1,000,000 gallons.

The best of engineering skill was lavished on her manufacture and many well known firms contributed to her equipment.

Let us now begin our examinations of the ship itself. After passing through the closely guarded gate of the navy yard and being escorted to the ship by an armed orderly, we report to the officer of the deck, resplendent in bright uniform and white gloves, on the quarter deck and are led down a hatchway to one of the upper decks proceeding aft, along which we come to the log room, which is the office of Lieutenant Commander P. L. Carroll, chief engineer.

Inspecting the Ship

As we express a desire to see the ship from stem to stern, Lieutenant Commander Carroll turns us over to one of the junior engineering officers and we start by reporting to the navigating bridge part way up the foremast and examine into the various apparatus for transmitting signals to the engine room for the control of the vessel and to half a dozen other parts of the ship, each of which has a particular and important function to perform. The picture shows a partial view of this bridge with the signal instruments used.

Next we are led through circuitous routes down steep hatchways, through narrow alleys and down more ladders, through deck after deck, until we have lost all knowledge of time and space. We find ourselves on the very bottom of the ship—the inner skin as the nautical term is—directly behind the rudder. The rudder is so large and ponderous that only in the most unusual circumstances can it be moved by hand. Here we meet the first application of electricity. A complicated mass of machinery, pistons, rods, valves, dials and electric motors combines to make up the steering gear engine. This machinery is operated and controlled directly from the navigating bridge by a control device.

Steering Gear Machinery

The courteous officer who accompanies us explains the workings of this machine and tells us that this is only one of five different methods of steering the ship. Whereupon we proceed to a watertight compartment directly aft to what is known as the auxiliary steering gear. And here we see four large wheels connected to a shaft which, when occasion demands, can be used to move the rudder by hand. But this shaft is also connected to an electric motor and by the simple turn of a switch can be operated electrically as well. It takes eight men to move the rudder by hand. Two other electrical units are situated in this compartment for rudder control and if all steering methods fail a "jury" rudder may be rigged off the stern.

Forward along the bottom of the ship we come to the propeller shafts—four in number—each operating an immense propeller. These shafts extend from the motors which operate them back through the ship and out at the stern, through what are known respectively as the starboard outboard shaft alley, starboard inboard, port inboard and port outboard alleys. The picture illustrates the size of these big shafts. The view presented is the starboard inboard shaft. It took more than an hour to get this picture. As the use of flashlights was prohibited artificial illumination by means of a 1,000-watt Edison Mazda lamp had to be obtained and half a dozen fuses were blown out before the picture could be lighted sufficiently to make a good exposure.

Following forward along the inboard shaft we go through several more watertight compartments, drop down a hatchway and find ourselves in the propelling motor room. This is the section of the ship which actually drives the propellers and the tremendous motor which meets our gaze gives an inkling of the power necessary to make the big shafts revolve.

The Propelling Motor

This motor, which, as already noted, is but one of four of similar size, stands twelve feet high from the floor and twelve feet wide. It generates 7,000 horsepower and obtains its current from other machinery which we will visit shortly.

This great motor, like the rest, is inclosed in a watertight compartment, protected by bulkheads, and if anything should happen to it the current may be cut off at once and directed to the operation of the three propellers which remain.

Still almost on the bottom of the ship, we come to what the engineers call the centre engine room. Here, spread out before us, lies a switchboard containing levers, dials, telephones, indicators and instruments for measuring electrical currents.

It is the main control station of the ship, containing the arteries through which the lifeblood of the vessel (the electrical current) courses. In fact, it is often called the heart of the vessel and is the most vital spot on board.

Here in this compartment the electrical current is received, measured and passed on to the motors which we have just left. From this station the propellers may be made to reverse or to go at full speed ahead; two propellers may be reversed while the other two are driven ahead. Here also any combination of control may be made up.

This is the turbo-generator section. There are two turbo-generators consisting of a Curtiss steam turbine direct connected to a powerful generator. This generator is operated by the steam turbine and produces the current we have been seeking. Each of the turbo-generators produces 14,000 horsepower. In technical language this spot within the ship is known as the power plant.

The turbine is an essential part of this plant. It will serve to illustrate another advantage of the electric drive, which, in simple language, is just this: A steam turbine to operate at its maximum efficiency must revolve a a relatively high speed, say 2,000 revolutions a minute. On the other hand, the propeller to be most efficient must revolve with comparative slowness, say 200 revolutions a minute. This is because if the propellers revolved at high speed they would merely churn up the water and fail to drive the vessel ahead.

Electricity acts as a connecting link between this high speed turbine and the low speed motor which drives the propellers. Mechanical gears, which, in the turbine driven vessel, have been used to reduce the turbine speed down to a suitable propeller speed, are entirely eliminated and the necessary reduction accomplished by simple electrical means.

The operating units of vital importance are each inclosed in separate watertight compartments. In addition, the machinery is grouped very close to the centre of the ship, as far as possible away from the sides.

To follow the power route to its source we must go still further forward and at this point come to amidships in the vessel. Nine huge steam boilers, arranged three in a compartment, store up the steam under a pressure of 250 pounds to the square inch and deliver it to the turbines.

The current which the two turbo-generators produce is used entirely in the actual propulsion of the vessel, the successive stages of which have been outlined. Important as it is, the New Mexico must have additional electrical energy with which to operate scores of auxiliary apparatus.

For instance, electric motors operate the 12-inch and 14-inch guns, blowers which supply the ventilation of the ship, electric fans, telephones, air, heaters, pumps, refrigerating machinery, wireless apparatus, kitchen appliances, laundry equipment and scores more, to say nothing of the lighting system. Motor driven machinery also operates the boat cranes and the anchor windlass, and there are scores of storage batteries which stand ready to keep the electric lights going should the main lighting system fail. It has been estimated that there are aboard the New Mexico no less than 350 electric motors.

The Officers' Quarters

Wending our way toward the daylight we are at once attracted to the officers' quarters and stop for a moment to pay a visit to the private cabin of the vessel's commanding officer, Captain A. L. Willard, a stockily built, broad shouldered naval officer of commanding personality.

Directly forward of Captain Willard's quarters is the officers' wardroom, which we next visit, a picture of which the reader may examine. The wardroom serves as a combination dining hall and recreation room. There are card tables, books and a phonograph with which to while away the all too short hours of leisure afforded an officer on active duty.

A long line of ranges extends along one side. This kitchen is run by steam and oil rather than electricity. The ranges burn oil instead of coal for fuel. The crew eats in the kitchen, sitting at long tables which, when not in use, are strung up against the roof.

All the baking is done electrically—electric motors operate the dough mixers and dough kneaders, while the loaves are baked in electrically heated ovens.

The New Mexico has twelve 14-inch guns and many of smaller calibre, including a battery of anti-aircraft guns. The larger calibre guns, three in each of the four turrets, are operated by electricity. The turrets are revolved and the guns elevated by electric motors. Ammunition hoists run electrically and there are electric gun loaders, while even the big guns are fired by electrical means, but the smaller calibre guns are generally operated by hand.

The Conning Tower

In examining into the control of these great batteries of destruction we come to one of the most interesting spots on the ship—the conning tower. Navy regulations designed to withhold important matters of military design forbid us from obtaining a picture of the conning tower. But it is permissible to describe it briefly. The conning tower is a shaft extending perpendicularly through the ship from top to bottom, with ladders running up and down the sides and convenient methods of transmitting instructions by means of indicators and telephones.

During an action the vessel's commanding officer usually stations himself in this "tower," which is also known as one of the several fire control stations, and transmits instructions concerning the proper operation of the guns.

Up in the mast we encountered one of the big "eyes" of the ship—an electrical eye, which can see for miles in inky darkness. The current for the operation of the General Electric searchlight comes from one of the turbo-generators heretofore described. The New Mexico is equipped with eight 36-inch searchlights.

Our visit to the ship took place on "field day," which is the nautical term for house cleaning day in the vernacular of the landsman. This accounts for the scaffolds. The crew had "turned to" to "clean ship" and were scrubbing off the vessel's sides when we appeared on the scene.

Electrical propulsion of marine vessels is opening up an entirely new era of scientific advancement and the day will come shortly when the seven seas will be dotted with electric ships just as surely as the automobile of the land has practically displaced the horse-drawn vehicle of the past. So far as our own navy is concerned, Secretary Daniels expressed the essence of the idea when he said:

"I think this country has cause to be proud of this achievement in engineering, not alone because of the pronounced success in this particular instance (referring to the New Mexico), but because of the assurance it gives us of the superiority of our capital ships to those of foreign countries."

Having proven the superiority of electric drive as applied to the propulsion of naval vessels in the United States, electrical engineers are now turning their attention to the adoption of similar principles to the driving of merchant ships, or cargo carriers, and to large passenger vessels.

A careful analysis of existing conditions has convinced many of them that the time is not far distant when these principles can and will be successfully applied to ships of many different types.

The March of Electricity

By Brewster S. Beach

SCARCELY fifteen years ago electricity had never been seriously considered as an agency in the propulsion of marine vessels, though the adoption of electrical current in the operation of streetcars, automobiles, railroad engines, etc., was an accepted fact.

The forward march of electrical progress, since the United States has not in recent years considered itself a seafaring nation, was comparatively slow to reach the ocean. Various applications of electricity as a motive force in driving locomotives and other vehicles of land transportation had reached an advanced stage of development, but the steamboat seemed to have "escaped," due probably to the difficulties surrounding the adoption of satisfactory and efficient electrical means of propulsion. This condition, however, was not destined to last very long.

The possibility of electrical propulsion of ships was talked about, indeed, as soon as electrical motors began to be used, but the actual serious study of its application awaited the development of the steam turbine. When the turbine development reached an advanced stage, combining high speed with light weight, engineers were ready to adopt electricity as a means of transmission between the turbine and propellers. So successful have they been in this respect that to-day the United States navy, as indicated by Secretary Daniels, has been won over to the principle of electric drive and has decided to equip all of its new capital ships with electrical machinery, while the theory is already making strides in the cargo-carrying mercantile marine field.

Thus electricity again comes to the forefront of scientific achievement. The electrically propelled ship has undoubtedly come—and come to stay.

Castor Oil for Aircraft Engines

A WRITER in "The Scientific American" dwells on the use of castor oil as a lubricant for the engines of aircraft of all sorts, showing it to be a most important commodity from a military standpoint. He says:

"Early in the year, the War Department and the Department of Agriculture joined forces in an energetic campaign to induce the farmers of certain sections of the United States to undertake the cultivation of quite 100,000 acres of castor bean plants, and, as a consequence of this patriotic appeal to our tillers of the soil, 108,000 acres were actually sown. The urge to this action was the need of something like 5,000,000 gallons of castor oil for the nation's fighting flying machines.

"Extensive experiments carried on by the Allies and later undertaken by the Bureau of Aircraft Production of the War Department proved conclusively that castor oil was the lubricant par excellence for fast-running motors for aerial service. Up to a point various blends of mineral and vegetable oils did well enough, but none of these was found capable of answering the supreme tests of sustained flight under a wide range of temperature and varied atmospheric conditions. Nature, somehow, had endowed the castor oil with characteristics that were singularly and strikingly united, as if the wants of mechanical flight had been curiously anticipated."

Alluding to some of the other uses to which castor oil is adapted, the writer goes on to say:

"The other fields of employment are much more extensive than most of us realize. For instance, castor oil figures to a large extent in the manufacture of substitute or artificial leather, which takes the place of natural leather in the upholstering.

"Castor oil is an essential component in some artificial rubbers, and there are various kinds of celluloid which depend upon this product of the castor bean.

"Castor oil furnishes a very satisfactory coloring for butter; and from castor oil is produced the so-called 'Turkey-red oil,' which is an important factor in the dyeing of textiles and in the treatment of the fabrics. One of its largest uses is in the making of transparent soaps.

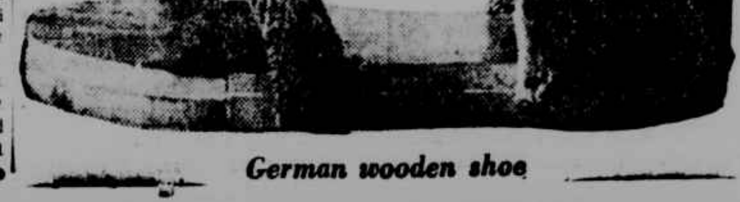
"Castor oil yields sebacic acid, which is superior to stearic acid in the manufacture of candles, and from it also is obtained caprylic acid, which lends itself to the composition of varnishes peculiarly suited to the polishing of high-class furniture, carriage bodies and paintings, and is extensively employed in the preparation of vellum, tracing cloth, etc. Caprylic acid plays a part in the production of ethers which are used by perfumers and confectioners. Castor oil is used in the making of certain waterproof preparations, and a liquid disinfectant is obtained from the 'seconds' or lower grade oil. The oil is an admirable preservative for various kinds of leathers, is extensively used in the leather industry and is particularly serviceable in adding to the service life of leather belting employed in heavy work. Our flypapers would not be so effective if it were not for castor oil, and the oil enters into the get-up of a great many adhevise agents.

"In the sugar mills of the West Indies, upon the railroads of India and other parts of the Far East and in British shipping circles castor oil has long been used as a mechanical lubricant; afloat, however, it is generally blended. In India the oil has been found to be an economical and superior illuminant—giving a markedly brilliant flame. Indeed, the peoples of India have found ways to utilize the oil and the refuse pomace which may suggest other services here in the future. The pomace contains from 6 to 7 per cent of nitrogen and a measurable amount of potash, and it is authoritatively said that the castor-seed cake possesses 2.81 per cent of phosphates. It is therefore easy to understand why the stuff makes an excellent fertilizer.

"In India, too, gas is obtained from a low grade of castor oil and is widely used for lighting. Finally, it has been found practicable to produce this gas from the seed cake after the oil has been extracted for other purposes. Notwithstanding the pretty general belief that the castor bean plant will not be touched by cattle, it is stated as a fact by competent authorities that the leaves, not the stalks, are widely fed to cows in India, and an added yield of milk is attributed to this forage. In Assam the foliage of the castor bean is cultivated largely for the purpose of feeding silkworms, and an excellent paper pulp can be made from the plant."

A German Wooden Shoe

THIS is one of the famous—or, as the Germans would say, infamous—ersatz shoes, to the use of which a large portion of the German people have been reduced through the blockade. The present specimen is manufactured by one of the largest shoe firms in Frankfort-on-Main. The sole is of two pieces of wood, hinged with scrap leather, so as to allow toe action. The strap passing across the front of the foot is of woven paper fibre. The heel counter is of the same material, while the ankle strap is made of scrap leather.



German wooden shoe

The Best Engineering Training

WE HEAR much these days of the kind of education which best fits the youth for his post-collegiate days. In "The Engineering and Mining Journal" an abstract from the bulletin of the Society for the Promotion of Engineering Education, by Professor George F. Swain, of Harvard University, deals briefly with the various ways the young man may prepare for his life's work. He declares:

"In the words of that fine old English schoolmaster, Richard Mulcaster, who wrote more than 300 years ago, which cannot be improved even to-day: 'The end of education and training is to help nature to her perfection in the completed development of all the various powers.' Its aim is to give the student power to meet the problems which life will bring him. Education is strictly utilitarian, using the word in its widest sense. The student should be taught first what is necessary; second, what is useful; third, what is ornamental. All of these are utilitarian, or useful in the largest sense. The objects to be aimed at are mainly two—discipline of mind, and interest; knowledge is secondary; but discipline should be acquired in subjects which will bring knowledge with it.

"No effective results will follow unless the student is interested and sees the value, use and application of what he studies. He cannot appreciate what he studies, or become really and profitably interested in it, in a concrete way, unless he can relate it to his experience. Education cannot turn out a finished product—that is to say, a man fitted to take a responsible position at once. It can only fit him to begin at the bottom of the ladder, and give him the foundation upon which to build. Experience is necessary before he can advance, but if he has a well trained mind and the proper attitude he should gain and assimilate experience rapidly and progress much faster than otherwise.

"We live in a world of other men. To make our way we need, besides a disciplined mind, many other qualities, such as knowledge of men, tact, personality, perseverance, energy, enthusiasm, power to concentrate, ability to work hard and effectively, and, above all, character. Education should aim to cultivate such qualities as far as practicable.

"Education may, on the one hand, be liberal or professional, or it may be vocational. The latter aims to fit young men specifically for a definite occupation, such as a manual trade, or for stenography or bookkeeping. Professional education has essentially the same object, except that a profession is broader in scope and requires a stronger and broader foundation of general principles.

"Vocational education may be concerned mainly with training the body or even one muscle, rather than with training the mind. Vocational education will not be considered here, but it may be remarked that it possesses in a high degree one of the most important elements, namely, interest. The pupil becomes at once interested in the work; it is related to his experience; he sees the use and meaning of it all the time. Its results are, therefore, likely to be satisfactory, even more so than the results of more formal education, and its importance is steadily increasing with the recognition of the fact that one of our main problems is to put the boy in the right place and fit him for a specific job.

"Engineering education is in a sense vocational, but, as the field of engineering is wide, and rests upon a substantial body of principles of science, it must be broad and must deal rather with those general principles than with any specific job. Yet the line between the two is not sharp, and many graduates of vocational schools make the best of engineers ultimately."