

THE ENGINES OF THE BATTLESHIP MASSACHUSETTS.

The Massachusetts is one of three heavily armed and armored first class battleships whose construction was authorized by Congress June 30, 1890. They were to be specially designed for coast defense, but at the same time were to possess sufficient seaworthiness to enable them to engage in offensive operations in distant seas. The construction of this trio was put in hand at once, two, the Indiana and Massachusetts, being built by the William Cramp & Sons' Ship and Engine Building Company, of Philadelphia; the contract for the third, the Oregon, being obtained by the Union Iron Works, of San Francisco.

The handsome full page engraving which forms the frontispiece of this issue was made from a photograph of one of the twin main engines of the Massachusetts, as they stood completed in the erecting shop at the Cramps' shipyard. There are two vertical, direct acting, triple expansion engines placed in separate watertight compartments, the engines being built exactly in duplicate. The cylinders are carried by inverted cast steel Y frames on one side and by hollow forged steel cylindrical columns on the other, which are bolted to a cast steel bed plate and strongly sway-braced. The high pressure cylinders are fitted with working liners and the intermediate and low pressure cylinders are steam jacketed on the sides and bottom. The diameter of the high pressure cylinder is 34½ inches, of the intermediate 48 inches, and of the low pressure cylinder 75 inches, the common stroke being 42 inches. The cylinder relief valves are placed on the valve chest casings, on connections between the steam and exhaust sides of the main valves. Single ported main valves, provided with balance pistons, are used, and of these there are one for the high pressure, two for the intermediate and four for the low pressure cylinder. Stephenson valve gear with double bar links is used.

The pistons are dished steel castings, and the piston rods, 7 inches in diameter, are of forged steel, as are also the connecting rods, which are 6½ inches diameter at the upper end and 8½ inches diameter at the lower end. The crossheads are of forged steel and they are provided with manganese bronze slippers faced with white metal. The eccentrics are of cast iron, the straps of composition and the rods of forged steel. The steam reversing engine, with 14 inch by 20 inch cylinder, is connected to an arm on the reversing shaft, and the hand reversing gear, consisting of wheel, wormshaft, pinion and rack, is also connected to an arm on the reversing shaft. At the forward end of the main engine will be noticed the engine for turning over the main shaft. It is attached to the frame of the high pressure cylinder and has a pair of cylinders 7 inches diameter by 7 inches stroke. It turns a worm on its main shaft, which in turn operates a vertical worm shaft gearing to a large worm wheel on the main shaft, as shown.

The main steam pipe, 13 inches diameter, is of copper, reinforced by steel bands placed 6 inches apart. The exhaust pipe to the intermediate cylinder is 16½ inches in diameter, that leading to the low pressure is 20½ inches, and the two leading to the condenser are 18½ inches in diameter. There are two main condensers in which the circulating water passes through the tubes, the total cooling surface being 12,710 square feet, and

in each engine room there is a Wheeler condenser connected with the auxiliary exhaust pipes. Each main engine is supplied with a Blake double, vertical, single acting air pump, in which the steam cylinders are placed directly over the pump cylinders, the pump and piston rods being in one length. For each condenser there is a double inlet centrifugal circulating pump which draws from the sea, bilge and main drain pipe and may discharge into the condenser or overboard. These pumps have each a capacity of 9,000 gallons per minute. They are driven by single cylinder, horizontal engines with cylinders of 6 in. stroke and 12 in. diameter. For fuller details of the piping, valves and condenser the reader is referred to a paper by C. H. Hayes, of the United States navy, on the contract trial of the Massachusetts, published in the Journal of the American Society of Naval Engineers.

The shafting is hollow and of forged steel. The line shafting is in two sections and is supported on three bearings. The propeller shafts are fitted with a composition casing from just inboard the stern tube shafting box to the propellers. The thrust bearings are of cast iron and are of the horseshoe pattern. The ped-

diameter is 15 feet and the length 18 feet. The tubes are 2½ inches outside diameter and their total heating surface is 3,647.5 square feet, the total heating surface of each boiler being 4,310 feet. The closed stokehold system of forced draught is employed, and air is supplied by ten Sturtevant blowers.

There are two vertical duplex double acting Blake pumps in each feeding fire room of the main boilers and in each fire room of the auxiliary boilers. The main feed pumps draw from the feed tanks, delivering only to the boilers, and the auxiliary feed pumps draw from the feed tanks, sea, bilge, secondary drain pipe and boiler and deliver to the boilers, fire main and overboard. Altogether there are thirty-four pumps of various kinds on the ship.

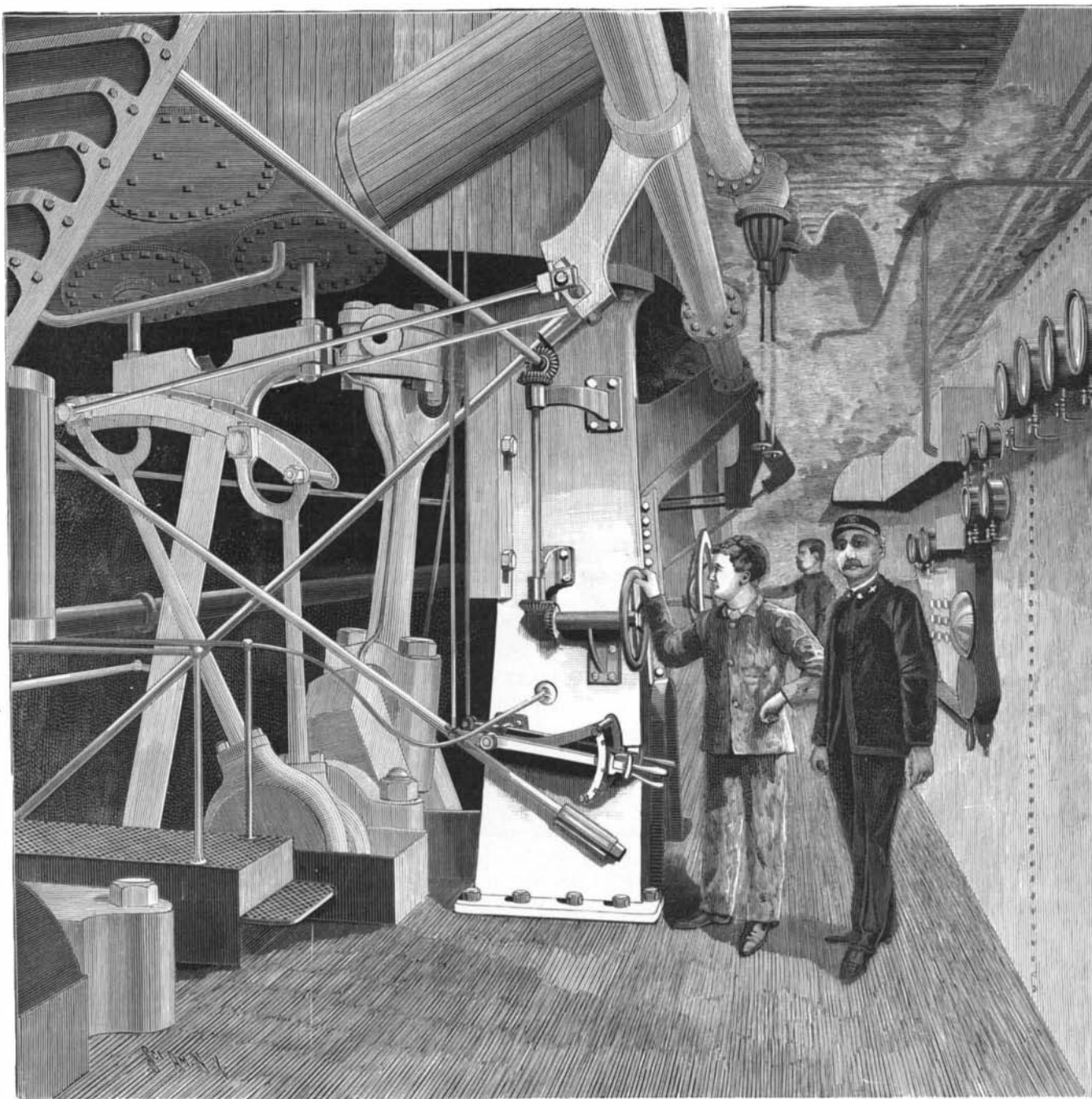
The work that has to be done by the boilers is understood when it is borne in mind that, in addition to supplying the main engines of over 10,000 horse power, they must supply steam for 86 auxiliary engines, or a total of 158 cylinders.

The official trial consisted of two runs in opposite directions, over a measured distance of 31 miles, with a smooth sea and generally favorable conditions. The

draught of the Massachusetts was 23.79 feet forward and 24.38 feet aft, and her displacement 10,265 tons. The average speed was 16.21 knots. The revolutions per minute were for the starboard engine 132.3 and for the port engine 133.06. The boiler pressure was 163 pounds and the pressure at the engines 155.6 pounds. The total indicated horse power was 10,402.6, and a maximum horse power of 11,440 was indicated during 15 minutes of the run to the south.

The boilers gave great satisfaction and there was no tendency to prime. The main engine ran without any heating of consequence, and it was necessary to use but little water. A careful examination was made of boilers and engines after the trial and all parts were found to be in excellent condition.

The engraving on this page represents the interior of one of the two engine rooms of the Massachusetts, showing on the right the longitudinal bulk-



ENGINE STARTING GEAR AND ENGINE ROOM BATTLESHIP MASSACHUSETTS.

estal carries a composition bearing lined with white metal, the cap of the bearing being of cast iron lined with white metal. There are 11 horseshoes, 21 inches diameter, made of a mixture of cast iron and steel, and lined with white metal. The crank shafts are 14 inches diameter, with a 6 inch hole; journals are 14 inches diameter by 17½ inches long. Crank pins are 15 inches by 17 inches, with a 6½ inch hole. Thrust shafts are 13¼ inches diameter, with 6 inch hole, and the line shafts are of the same dimensions.

The propellers are of manganese bronze and are three bladed. The pitch is variable, from 14 feet 3 inches to 16 feet 3 inches. The bosses are secured to the shaft by a feather key and a steel nut which is screwed on and locked in place.

There are six steel boilers, four double-ended main and two single-ended auxiliary, all of the horizontal fire tube type. The former have eight and the latter two corrugated furnaces. The longitudinal joints are treble riveted, with double butt straps. The joints on the circumference are lapped and treble riveted. The furnaces are fitted with Cone's patent shaking grate bars. The steam pressure is 160 pounds. The shell plating of the main boilers is 1½ inches thick; the

head. In the center is seen the starting gear, and we have a glimpse of one of the heavy connecting rods and the link motion.

We are informed by Mr. George W. Melville, engineer-in-chief of the navy, that circumstances prevented the carrying out of a trial for coal consumption of sufficient length to give reliable data.

To Blacken Wood.

M. Koninck suggests the following method of blackening wood, which has the advantage of resisting acids and alkalis:

A.	
Cupric chloride.....	75 parts.
Sodium chlorate.....	67 "
Water.....	1000 "

B.	
Aniline hydrochlorate.....	150 parts.
Water.....	1000 "

Paint the wood with A and a short time after with B, and remove with a damp cloth the yellow powder that forms. Repeat this operation every day till the desired color is obtained, and then rub the wood with vaselin or linseed oil. By using potassium bichromate instead of the soda salt, a good black color is obtained at once.—The British Journal of Photography.

Over 616 Miles in 24 Hours.

M. Cordang, the Dutch long distance rider, has covered himself with glory. On the evening of September 15, at the Crystal Palace, London, he started against the 24 hour record. As the result will show, his pace was terrific from the start to the finish. In 19 hours 17 minutes and 28 1-5 seconds he lowered the world's record and had covered 500 miles. He bent to his work in the last four hours, and without slackening his speed raced for a record that will stand for a long time, even in this record breaking age. As he neared the end he gathered himself together and raced like the wind, says the American Wheelman. He finished his race in a grand burst of speed, and at the end of his ride appeared but little the worse for his great race. He covered 616 miles and 340 yards.

Cordang was entered in the recent twenty-four hour race at Paris, but had an accident in the early part, and was compelled to withdraw. He was greatly chagrined at this, as he had confidently expected to beat Huret, who in that race covered over 564 miles in the twenty-four hours. He has been training assiduously ever since, and the record made was an evidence of the good cause he had for confidence in himself. Cordang has not shown any very remarkable speed heretofore this year, but has always been rated as one of the best long distance riders. In 1895 he won the 100 kilometer championship, and he also holds several of the Dutch records.

Return of the Peary Party.

Although Lieut. Peary's latest Arctic venture has not been marked with any sensational discoveries, still it has been crowned with great success. There was no attempt made to reach a very high latitude, the idea of the expedition being to establish a principal base of supplies from which the explorers could start next season, when Lieut. Peary with one or two companions will make a dash for the pole. The "Hope" came into Sydney, C. B., on September 20, burning her last ton of coal and with her bulwarks smashed. The vessel was nearly as deep in the water as when she left the port, for the great Cape York meteorite, the largest in the world, was in the hold bedded in tons of ballast. Lieut. Peary found that the Esquimaux of the Smith Sound region were eager to co-operate with him in the work of exploration to the north of Greenland, which will be attempted next year. The party visited Cape Sabine and procured relics of the ill-fated Greely expedition, most of whose members perished of starvation at that point. The various parties which had been left at different points on the way north were taken on as the steamer came southward. The summer in Baffin Bay was marked by almost continuously stormy weather and an unusual scarcity of ice. The Hope will remain at Sydney only long enough to coal and will then proceed to New York to land the meteorite.

The meteorite is of great interest, although there has been some talk that it was not really a meteorite. It will make a valuable addition to the Natural History Museum and will be worth all the expense and labor of the voyage. Forty-five years ago, when Inglefield returned to England after his explorations along the northwest coast of Greenland, he reported that the natives in the neighborhood of Cape York tipped some of their weapons with a metal which was obtained from some big stones on the coast. Inglefield did not find these stones, which were only discovered by Peary on his second visit to northwest Greenland. As was suspected, the rocks he discovered proved to be meteorites of uncommon size, and one of them proved to be by far the largest meteorite known.

The Enchanted Mesa of New Mexico.

A survey has recently been made of the "enchanted mesa" of New Mexico by a party sent out by the Bureau of American Ethnology. For a long time there has been a tradition that the "mesa" was inhabited, but that it was abandoned in consequence of the destruction of the pathway leading up one of its precipitous sides, the catastrophe being doubtless due to a cloudburst. The traditional catastrophe was magnified by repetitions, so that the Indians came to regard the elevated plateau as inaccessible.

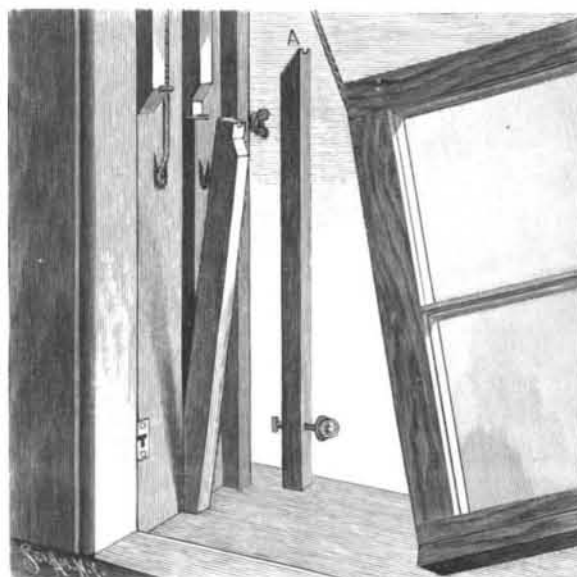
Some years ago, Mr. F. W. Hodge, of the Bureau of Ethnology, determined to make the ascent, but he was deterred on account of the sentiment of the Indians, who held the mesa sacred. During the past summer, Prof. William Libbey, of Princeton University, ascended the mesa without finding any evidences of occupancy. Reports of this expedition having reached the neighboring Indians, they finally consented to have the party sent out by the Bureau of American Ethnology ascend the height. After measuring the eminence by triangulation, the party ascended along the ancient route and encamped on the summit for the night. Mr. Hodge examined the ground critically and Major Pratt, United States Deputy Surveyor, made a survey of the summit. A. C. Vroman, of Pasadena, Cal., obtained a number of photographs. Several potsherds, two broken stone axes, a fragment of a shell bracelet, and a stone arrow point were the chief evidences of former occupancy found on the crest, but potsherds, etc., were found

in the talus swept down from the summit. The Indian tradition is therefore affirmed. No great difficulty was found in ascending the summit, save for a few feet at the top of the cleft. This chasm was spanned by means of an extension ladder.

Prof. Libbey, who made the ascent in July, reached the summit by throwing a cable over the mound by means of a cannon. The cable once having been secured, the ascent was made by means of tackling arranged for the purpose.

IMPROVED SASH HOLDING AND REMOVING DEVICES.

A novel form of sectional and removable window bead, which holds a sash to slide vertically, and which may be removed to permit the removal of the sash, is shown in the accompanying illustration, and has been patented by Richard Bohrisch, of East Las Vegas, New Mexico. The outer bead is a permanent one and the two inner beads are made in sections, the upper sections permanent and their lower ends beveled and transversely apertured, a plate adapted to receive a threaded pin being secured in the window frame under the lower end of each section. The removable section of the inner bead, A, has its upper end beveled to correspond with the bevel at the lower end of the upper section, to which it is removably secured by a thumb nut and threaded pin at the top and a bolt entering a T shaped slot at the bottom. The removable section of the intermediate or parting bead is similarly secured in position at the top, its lower end being inserted in an opening in the base of the window frame. In a re-



BOHRISCH'S SASH HOLDING AND REMOVING WINDOW BEADS.

cess in the guideway of each sash is a hook, adapted to engage an eye on the end of the sash cord, when it is desired to disengage the latter from the sash.

Labor Saving Insects.

That certain flies will steal a ride on the back or wings of some larger insect, and that this labor saving process may be habitual, is indicated by the observations of the Rev. A. E. Eaton, who noticed in Algeria a small fly of the Borborinæ group riding on the backs of big coprophagous beetles. They settle down on the prothorax, and on the base of the wing covers, sometimes half a dozen females on one beetle.

"The beetles occasionally throw themselves on their backs to try and get rid of them by rolling; but the flies elude all their efforts to dislodge them, dodging out of harm's way into the joinings of the thorax and out again, and darting from back to breast and back again in a way that drives the beetle nearly mad. In vain she scrapes over them with her legs; in vain does she roll over or delve down among the roots of the herbage; the flies are as active as monkeys, and there is no shaking them off."

A somewhat similar case has been reported by Mrs. Slosson, says The Independent, who observed at Franconia a lacewing fly (Chrysopa), which seemed to have a black raised spot upon each wing, and others with but a single spot. She caught other chrysopas, and in the net with one of them was a minute Cecidomyia fly still clinging to the wing of a lacewing fly. It apparently is a tramp fly, stealing a ride on the larger insects, though the lacewinged flies are not rapid fliers, nor do they fly to a great distance.

THE Westinghouse Electric and Manufacturing Company has received from its European company notice of the award to it by the Metropolitan Electrical Supply Company of the contract for a large electric lighting plant to be installed in London. The apparatus will be of the multiphase type, involving the use of the Tesla patents, which are owned in England by the Westinghouse Company. It is understood that the contract amounts to between \$350,000 and \$400,000.

Science Notes.

The Prince of Monaco is said to have completed his season's researches in the Azores.

Two new asteroids have been discovered between Mars and Jupiter by M. Charlois, of Nice, bringing the number discovered by him up to eighty-six. Palisa, the Austrian astronomer, has discovered eighty-three.

The Evelyn Baldwin has arrived at Christiania, from Spitzbergen, whence she sailed northward until stopped by pack ice. She reached latitude 80° 45' and secured valuable geological and botanical collections for the American colleges.

An English steamship engineer has recently acquired the distinction of being probably the only man ever bitten by a West African double-horned viper who has lived to tell of it. The doctor kept him full of brandy and injected iodine into the wound. His temperature rose to 107° 3.

Further discoveries have been made in the wonderful ice caverns opened up at the foot of Cow Mountain, Colo. Three chambers have been opened, the walls and ceilings being covered with great masses of ice in grotesque forms. In the center of one of the rooms is a lake 40 x 65 feet, with no apparent outlet.

Mr. Harmsworth, who defrayed the expenses of the Jackson expedition in Franz Josef Land, has declared that he will send two ships to the Arctic next season and keep an expedition in the Arctic regions till a complete map can be made of all the accessible parts of the North Polar world. The Jackson expedition has cost him \$200,000.

Hon. Charles D. Wolcott, Director of the United States Geological Survey, left San Francisco on September 11, for the Yosemite Valley. He proposes to make topographical maps on a scale of two miles to the inch of all the forest reserves in California, including recent additions, comprising 6,647,000 acres. The distribution of forests will be pointed out on this map, showing the commercial and uncommercial timber, agricultural lands, settlements, roads, houses, etc.

An interesting experiment is to be tried in connection with the Paris Exhibition of 1900. The authorities intend to establish a workmen's co-operative restaurant for the benefit of the men engaged in erecting the exhibition buildings. Arrangements are being made to supply a good meal at a very moderate price. The workmen will have the greater part of the profits divided among them, as well as the dividend, which is expected to reach six per cent of the outlay of each man.

"M. Marey has contributed to the Paris Academy an account, by MM. V. Tatin and Ch. Richet, of trials of an aeroplane invented by them," says Science. "Their first experiments were made in 1890, but the machine was wrecked. A new machine was then constructed, with which the first trial was made last year with some success. In a second trial in June last the aeroplane traveled through the air 170 meters [558 feet] at the rate of 18 meters [59 feet] per second. The machine weighed 33 kilogrammes [73 pounds]. The authors compare their results with those obtained by Prof. Langley, and, while admitting the greater distance traveled by the aerodrome, claim that their machine had the advantage of greater weight and greater speed."

The colors of the different races depend upon the pigment in the epidermis, especially in its deeper strata. M. Breul, a recent French authority, finds according to Science that the coloring matter is in the interior of the epithelial cells, "while even in the negro the intercellular spaces are white. The pigment itself may be quite black, or of any shade up to a light yellow. It may be confined to the nucleolus or extend over the cell. A close examination shows that it is distributed in patches over the skin, between them the tissue being colorless. This is true even of the black races, although in them the patches are close together and may not be discernible unless the skin be stretched. This distribution of the coloring matter is the same in all races, and its actual amount is probably the same, the difference in hue resulting from the darker or lighter character of the pigmentary grains."

The seventh session of the Australian Association for the Advancement of Science will commence on January 6, 1898, the place of meeting being Sydney, says the Lancet. The objects of the association are to give a stronger impulse and a more systematic direction to scientific inquiry; to promote the intercourse of those who cultivate science in different parts of the Australian colonies and in other countries, to obtain more general attention to the objects of science, and a removal of any disadvantages of a public kind which may impede its progress. The president-elect, who also holds the office of permanent honorary secretary, is Prof. A. Liversidge, M.A., LL.D., F.R.S. Besides the general meetings, excursions will be organized to various places of interest in the neighborhood, and this portion of the congress will no doubt be by no means the least appreciated of the proceedings, for the scenery of the Blue Mountains is as beautiful as any in the world.

SCIENTIFIC AMERICAN

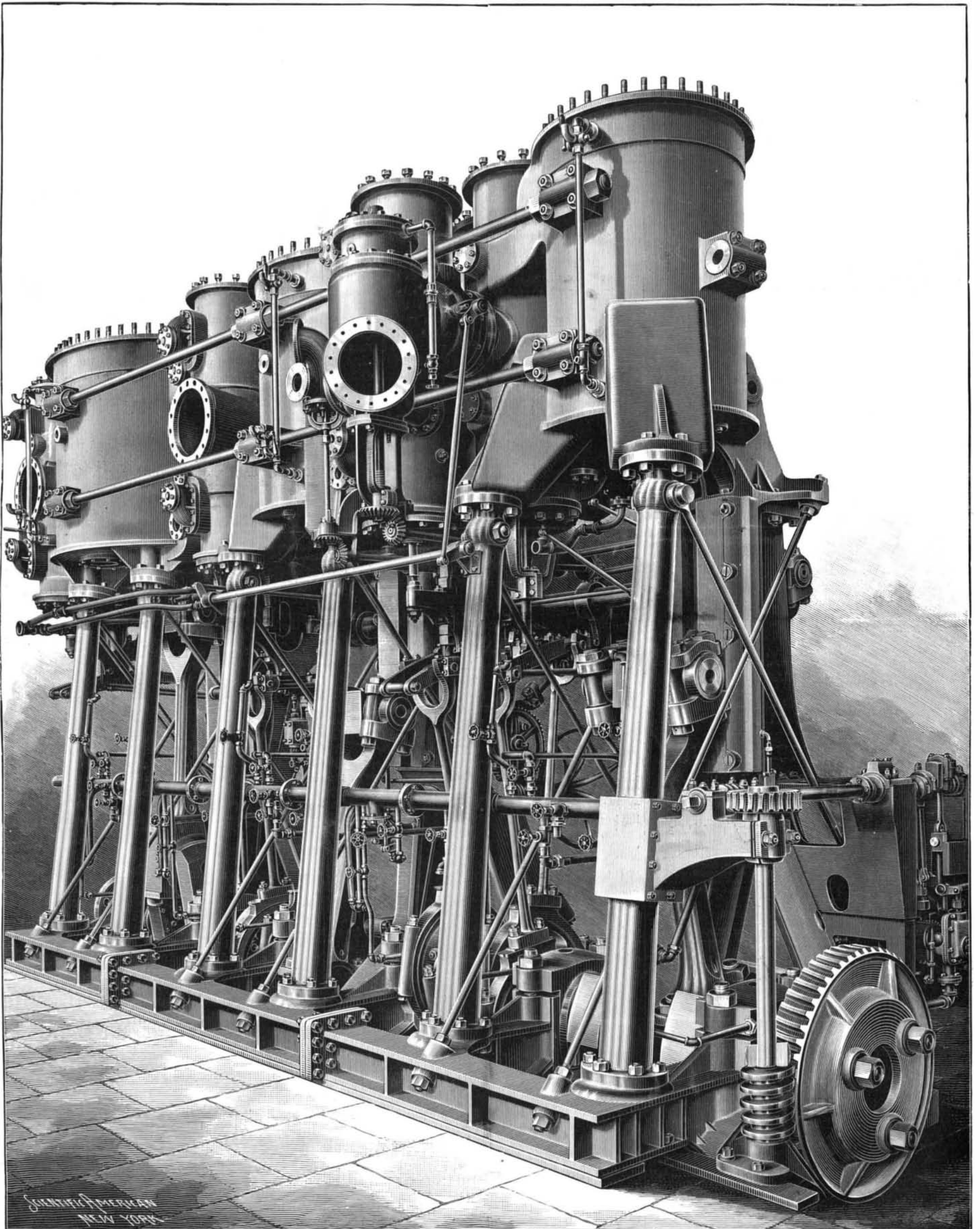
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ONE OF THE TWIN ENGINES OF THE BATTLESHIP MASSACHUSETTS, U. S. N.—[See page 213.]