MOTORS FOR THE NEW YORK CITY SUBWAY.

The Interborough Rapid Transit Company, more popularly known as the New York Subway, will operate two classes of train service. The first will consist of five-car local trains, composed of three motor cars and two trailers, making an average speed of approximately 16 miles per hour. The second will be eight-car express trains, comprising five motor cars and three trailers, making an average speed of 25 miles or more per hour. The same motors and gearing will be used for both classes of service. The motors, which are to be supplied by the Westinghouse Electric and Manufacturing Company, were designed especially for this purpose, and were made to fit the particular conditions and requirements involved. One of these requirements, and perhaps the most difficult, made necessary the designing of a motor of large capacity to fit into a limited space. As a result, the present motors are probably of smaller size for their output than any built heretofore.

The nominal capacity of the motor is 300 amperes at 570 volts, or 200 horse-power, for one hour. With this current and voltage, a tractive effort of 4,150 pounds is developed at the periphery of a 33-inch wheel, at a speed of 19 miles per hour. Although designed for an average voltage of 570, the motor will operate satisfactorily with voltages up to 625. It will carry loads up to 500 amperes without injurious sparking.

The motor has a field frame of cast steel, divided into halves on the line of the centers of armature and axle, and completely surrounding the axle. There are thus no separate axle bearing caps, and the number of pieces is consequently reduced to the least number possible for an easily accessible motor. The top half of the field can be readily lifted off, and access gained to the interior for inspection and repairs.

The four pole-pieces are made of laminated steel punchings held between heavy end plates and secured by rivets. The field coils are made of copper strap wound on edge. The insulation between turns consists of asbestos and mica, held in place by shellac and baked at a high temperature under heavy pressure, so that the coil and insulation make a solid mass. The completed coil is sealed in a curved metal case, from which it is insulated by molded mica made like the V-rings of a commutator. This construction gives a coil which is absolutely fireproof, moisture-proof, and practically indestructible.

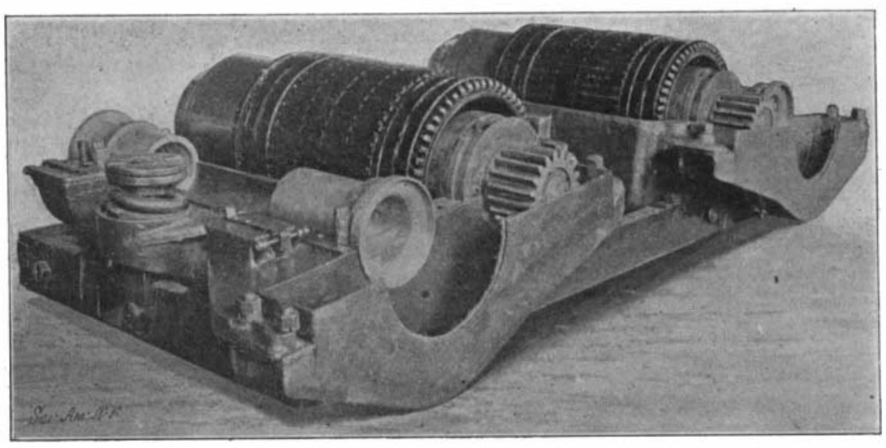
The armature is 20 inches in diameter and weighs 1,930 pounds. It is of the slotted drum type, and is composed of sheet-steel punchings assembled on a cast-iron spider. The commutator is also carried on the same spider, and the shaft may thus be removed and replaced, should this ever become necessary, without disturbing the armature winding or its connection to the commutator. The winding itself is of the two-circuit type, and is of ventilated construction. There are 53 slots and 159 coils, i. e., three coils per slot. Each coil consists of a single turn of copper strap. The coils are held in the slots by wedges of special unshrinkable material, which will withstand a high degree of heat without injury. This is a valuable feature, and gives a construction which is stronger and safer than the use of bands. It also greatly facilitates the removal and replacing of the armature coils. The armature insulation consists essentially of mica, which extends between turns at all points. The mica is protected by a sufficient amount of fibrous material to insure against deterioration due to mechanical vibration. This fibrous material is treated with a moisture and oil proof compound, forming an insulation capable of withstanding very high temperature without injury. The commutator is composed of 159 rolled and hard-drawn copper bars, held in place by two steel V-shape rings, one of which serves as an oil guard to thoroughly protect the mica from oil or grease. A low voltage between the commutator bars is secured, decreasing the liability of flashing from any cause. The bars are insulated from each other by sheets of mica of a hardness that insures its wearing at the same rate as copper. The mica separating the bars from the rings is 1-16 inch thick, and the mica ring also separates the bars from the commutator spider. The wearing surface of the commutator is 16¼ inches in diameter and 9⅞ inches long. The bars are of a depth which allows a reduction in diameter of 2 inches.

The brush holders consist of two cast-brass arms, each carrying three carbon brushes ⅝-inch by 3 inches in section. The brushes slide over finished surfaces, and each is pressed on the commutator by a spring finger. The tension of these fingers is readily adjustable, and the brush holder arm is arranged for radial adjustment to allow for wear of the commutator. Copper clips are bolted to the carbon, and these clips are connected by flexible shunts, of ample capacity, to the body of the brush holder, thus relieving the springs from carrying the current.

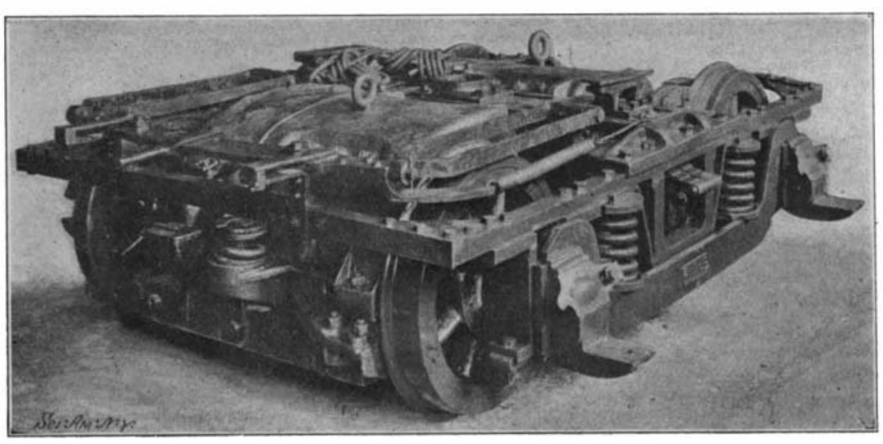
The completed motor will stand an insulation test between winding and motor frame of 4,500 volts alternating momentarily, or a test of 3,000 volts for one minute.

The armature bearings are contained in housings which are securely held between the halves of the field frame. These and the axle bearings are lubricated by oil fed to the journals by waste, in accordance with standard railway practice. The oil boxes are formed so that the waste will pack itself against the journals.

The gears are solid, of cast steel, with cut teeth. The pinions are forged steel with cut teeth. The gear case is made of malleable iron planed to a tight joint, with a suitable opening at top having a hinged cover. It is supported at the ends by horns cast on the motor frame and so shaped that they support the gear case without side strain, the weight being carried in its own place. The whole motor can be dismantled with great ease and dispatch without the use of any special tools. Its total weight including gear, gear case, etc., is about 6,600 pounds.



MOTORS FOR NEW YORK SUBWAY. UPPER HALF FIELDS REMOVED.



NEW YORK SUBWAY MOTORS MOUNTED ON TRUCK.

The Current Supplement.

The current Supplement, No. 1426, opens with an instructive article on the great viaduct at Fort Dodge, Iowa. Several excellent illustrations accompany the article. Our Consul-General at Berlin gives a very valuable account of lignite, peat, and coal-dust fuel in Germany. Another technological article on a somewhat allied subject treats of the value of rational methods in coke production. Emile Guarini continues his lucid exposition of the development of the Marconi system of wireless telegraphy. Prof. W. Smart discusses industrial trusts. A readable description of Japanese lacquer and of its preparation and application is presented by Randolph I. Geare. Among the many things taught by the Correspondence Schools at Scranton is the method of instructing railroad men in the use of the air-brake. An article on the instruction given is published, together with some helpful pictures. Prof. A. W. Bickerton, whose letters on Star Explosions published in the Scientific American are doubtless remembered by our readers, outlines an original theory of cosmic evolution. Prof. John H. Poynting, well known to physicists the world over, tells of some recent studies in gravitation.

A Proposed Alliance of Astronomers.

In a pamphlet entitled "The Endowment of Astronomical Research," Prof. Pickering, of the Harvard Astronomical Observatory, proposes a combination of the world's observatories on a trust basis. He believes that by such a combination it will be possible to utilize existing astronomical stations to the utmost capacity.

Prof. Pickering shows that the astronomical industry is by no means as unimportant as one might suppose. The observatories of the world represent an investment of more than ten million dollars. Their expenditures, moreover, are large. The money spent varies from a few thousands to $85,000 per year.

The great observatories have so far shown a singular incapacity for concentrated effort. In 1891 fifty observatories agreed to watch the opposition of the planet Eros. But so far as is known, only two or three of them have made the reductions needful to give value to their observations. Sometimes it has happened that a great observatory has not been adequately equipped with a telescope; sometimes a great telescope stood ready for use, but no astronomer was at hand to use it; sometimes the collected observations of a famous astronomer have lain unpublished for years for want of a few hundred dollars.

Prof. Pickering has suggested the appointment of an advisory board of leading astronomers of the United States, who would meet at regular intervals for the purpose of considering how resources may be expended in order to receive the maximum scientific return. Details of organization are also outlined.

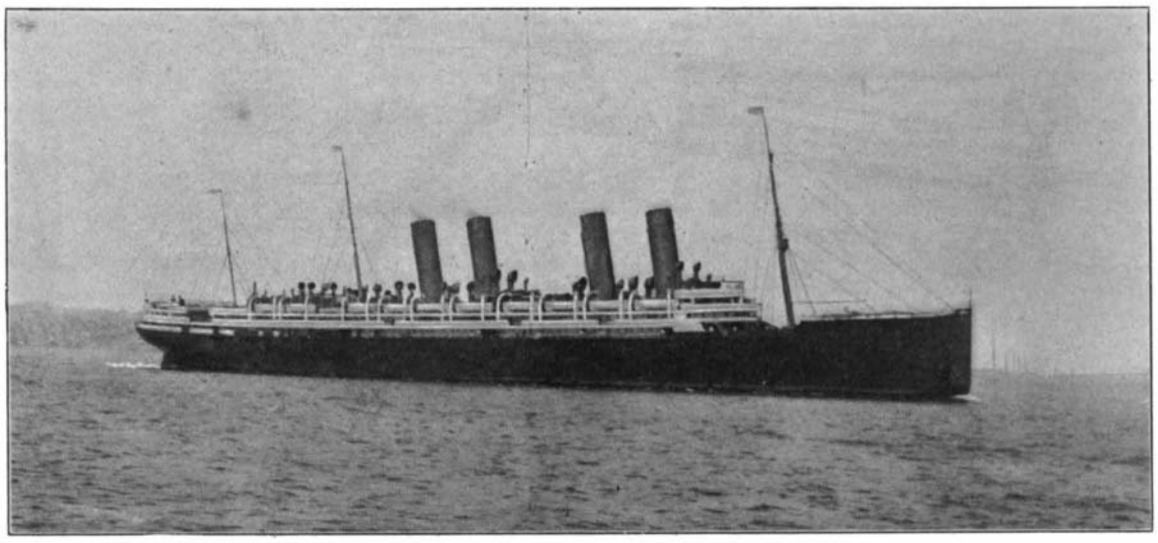
THE LATEST ATLANTIC LINER, "KAISER WILHELM II."

If we consider her great size, unprecedented power, and the exceptional beauty of the boat, both within and without, it must be admitted that there was never a great transatlantic liner slipped into the port of New York at the close of her maiden voyage so modestly, or made fast at her dock so quietly as the new "Kaiser Wilhelm II." Ships that are notable are put afloat in these days in such rapid succession, that it takes a very big or a very fast boat to be entitled to special notice. Of the recent great liners there have been the "Oceanic," 705 feet over all, the longest ship afloat since the "Great Eastern;" the "Deutschland," with her average Sandy Hook-Plymouth speed of 23.5 knots an hour, the fastest of the great liners; the "Celtic" and "Cedric," each 700 feet long and 75 feet beam, and over 37,000 tons maximum displacement, dimensions which entitle them to be called the widest and largest ships afloat. Then a couple of weeks ago we chronicled the launch of the "Minnesota," which, with her molded depth of 56 feet, is the deepest ship in the world, her displacement being somewhat less than that of the "Cedric" and "Celtic."

The "Kaiser Wilhelm II.," the latest of these big liners, 706.5 feet in length over all, is remarkable as being the longest ship in the world, and also the ship having the greatest horse power, the contract requirement being that she should indicate 40,000 horse power, which is 7,000 more than the stipulated horse power of the "Deutschland." The complete dimensions of the new boat are, length 706 feet, 6 inches; beam, 72 feet; molded depth, 52 feet, 6 inches; load draft, 29 feet; and displacement, about 26,000 tons. The double bottom, which extends the full length of the ship, is divided into twenty-six compartments, while the hull itself is divided into nineteen watertight compartments. There are seven decks, known respectively as the orlop, lower, main, upper, lower promenade deck, upper promenade deck, and awning or boat deck. The vessel thus carries one more deck than is common in large passenger ships of her type, her predecessors having only one instead of two promenade decks; and by the way, these two decks are truly magnificent in their clear, unobstructed sweep from the bridge to within a short distance of the taffrail. To those passengers who spend most of their time on deck, and much of it in a steamer chair, the doubling of the promenade deck accommodation will be a positive boon. In her general appearance the new ship shows the characteristic features of the German boats that have come from the Stettin yard. She has the same pronounced sheer and perceptible lift of the sheer line toward the stern, and she carries the usual four funnels, although there is an innovation in the fact that she has three masts, placed somewhat the same as in the "Oceanic." As a result of the great height of the upper works of the "Kaiser Wilhelm," she does not look to be as long as she actually is. The best impression of her size is gained when standing on the captain's bridge or on the second bridge astern at a height of between 60 and 70 feet above the water, and letting the eye range up and down the full 706 feet length of the vessel.

The passenger accommodation includes 290 first-class cabins and 107 second-class, and one of the "show" features of the ship is her two imperial suites, each of which includes a dining-room, drawing-room, bedroom, and bathroom, all most daintily and tastefully decorated. There are also eight suites that include sitting-room, bedroom, and bathroom, and also eight state cabins with bathroom adjoining. The most spacious room in the ship is the first-class saloon, a magnificent room, 69 feet broad and 108 feet long, which provides sitting accommodations for 554 passengers. The second-class saloon accommodates 190 passengers. Special features are a children's saloon, a typewriting room, and a safe deposit department. The four kitchens, the largest of which is about 55 feet by 30, can cater to about 800 first-class passengers, 400 second-class, and 1,100 third-class. The crew alone amounts to a complement of 600 individuals, and of these the engine-room staff requires 237.

The chief interest of this remarkable boat centers in the engine room, which is arranged on a principle entirely novel in transatlantic travel, although it has been adopted in some warships. The engine room is made up of four separate compartments, with a complete engine in each. There are two propeller shafts, and two engines are arranged in tandem on each, a stuffing-box arrangement being used on the crankshaft where it passes through the transverse watertight bulkhead separating each pair of engines. The engine in each compartment is a complete quadruple-expansion, four-cylinder unit, and its contract indicated horse power, as given out by the company, is 10,000, although it will undoubtedly prove to be nearer 11,500 when the engines have sweetened out and found themselves. This is shown by a comparison between the engines of the "Kaiser Wilhelm" and those of the "Deutschland." The engine on each shaft of the "Deutschland" consists of two 36.6 high-pressure cylinders, one 73.6 first intermediate, one 103.9 second intermediate, and two low-pressure cylinders 106.3 inches in diameter, the common stroke being 72.8 inches. On each shaft of the "Kaiser Wilhelm II." there are two 37.5-inch high-pressure cylinders, two 50-inch first intermediates, two 75-inch second intermediates, and two 112.2 low-pressure cylinders, their common stroke being 70.8 inches. The steam pressure in both cases is the same, 213 pounds to the square inch. Now the engines of the "Deutschland" have always indicated much more than contract power, the greatest average for the whole trip being 37,500 or 4,500 more than the contract. The contract calls for 40,000 horse power in the "Kaiser Wilhelm," and probably toward the close of the season she will be averaging over 45,000 horse power for the eastward passage and her average speed will probably be between 23.75 and 24 knots an hour.



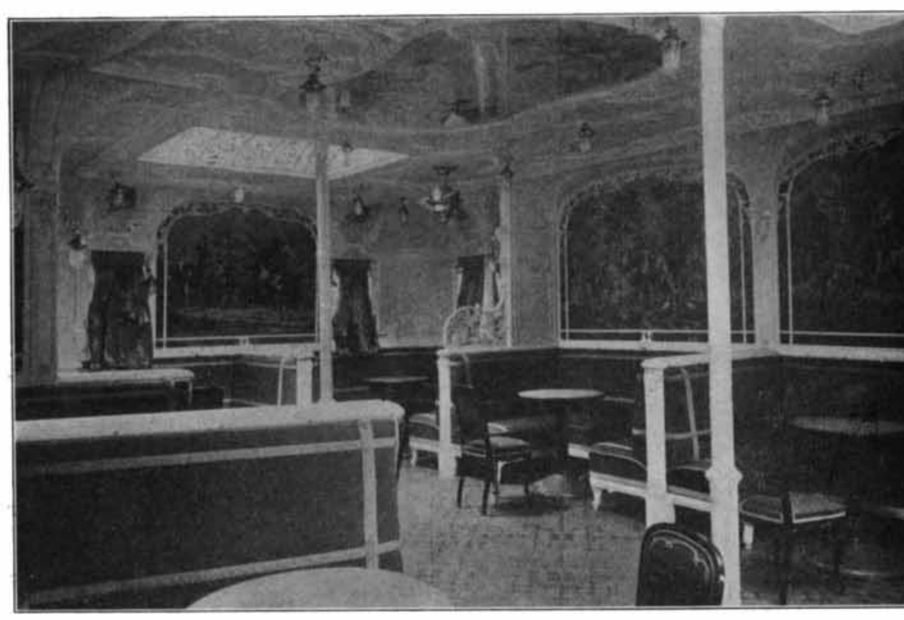
THE LATEST ATLANTIC LINER, "KAISER WILHELM II."

Length, 706½ feet. Beam, 72 feet. Depth, 52½ feet. Horse power, 40,000. Speed (expected), 23½ knots.

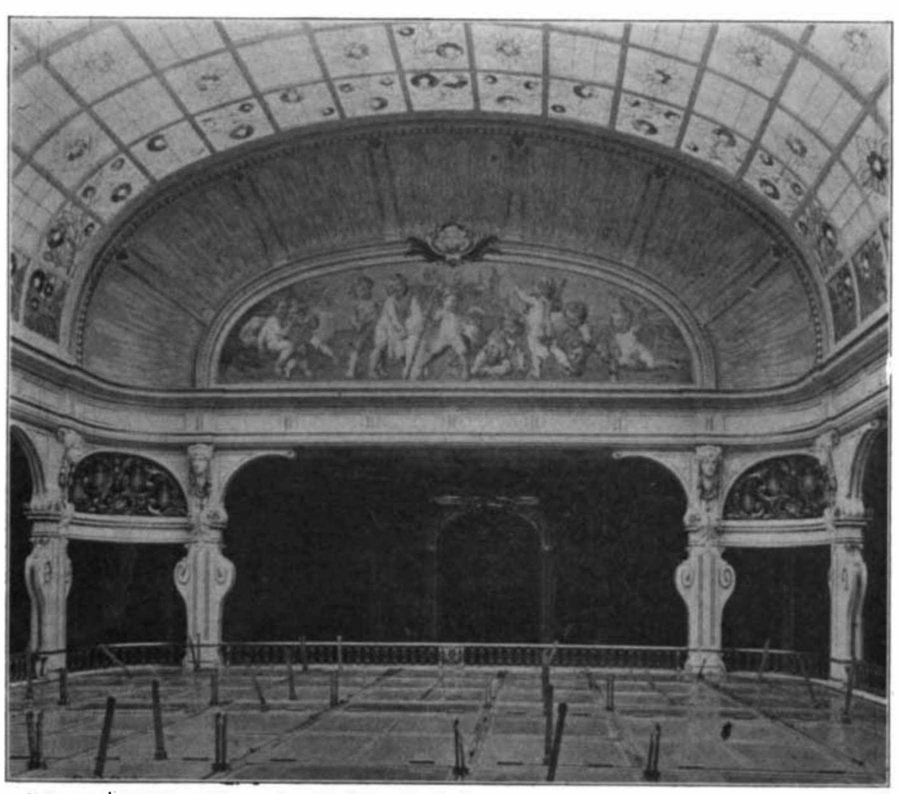
The following particulars of the motive power will be of interest: There are two propellers, each 22 feet 10 inches in diameter. The driving shaft is 230 feet long and weighs 253 tons, the weight of the crankshaft alone being 108 tons 15 hundredweight. To condense the huge volumes of steam that are delivered, hour by hour, to the condensers requires 46½ miles of condenser tubes. The vessel has nineteen boilers, twelve of which are double ended and weigh when empty, 114 tons apiece. The total heating surface of these boilers is over 2½ acres. The coal bunkers have a maximum capacity of 5,239 long tons of coal, and the coal consumption is expected to be about 650 tons per day. On the run over the ship was not pushed, as the engines and plant were entirely new; but nevertheless, she averaged 22.1 knots an hour, and there was no trouble whatever with the engines; the pumps, etc., working to perfection and the bearings remaining cool.

A section of the submarine cable between Cienfuegos and Santiago, in the Caribbean Sea, has recently been raised, with some very interesting results. The cable was manufactured in 1873, and laid off Cienfuegos, Cuba, in 1881. Some few months ago a question arose as to the durability of cables covered with India rubber, as in this case, and it was decided to raise the Cienfuegos cable and subject it to tests. The line was picked up in 1,350 fathoms of water in April last, and received at the works of Messrs. Hoopers, at Millwall, in June. The tests of the core showed that after twenty years' submersion it was still in perfect electrical condition. An examination of a foot specimen proved that the insulation was in good mechanical condition, and that the copper conductor had not suffered from the attacks of any sulphur in the rubber.

MAIN SMOKING ROOM.

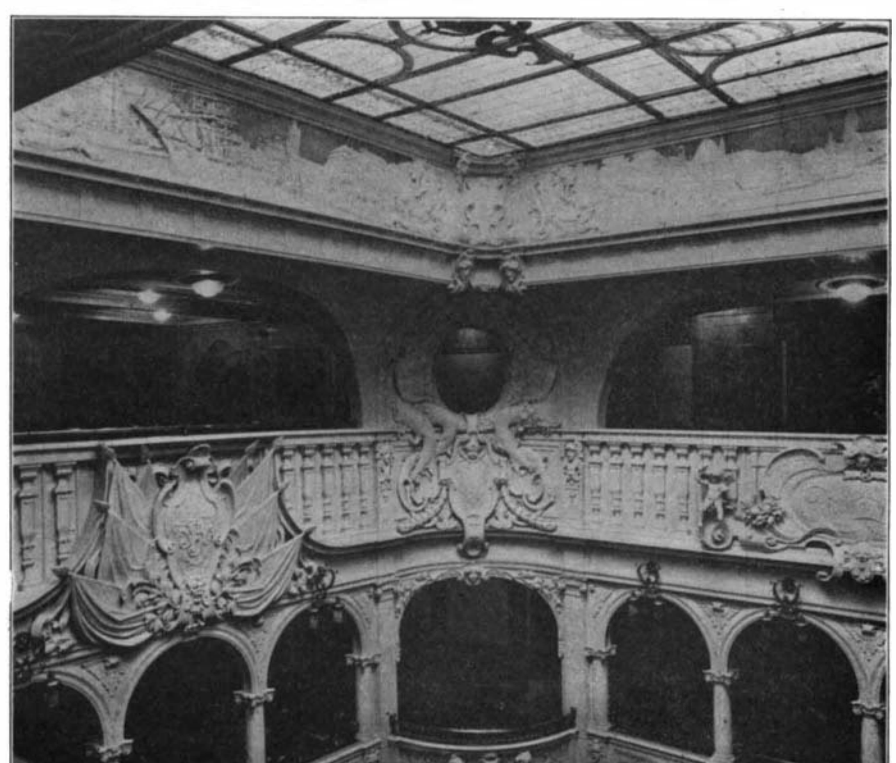


VIEW IN LADIES' PARLOR, SHOWING COSTLY WALL TAPESTRIES



Photographs made especially for the Scientific American.

THE HANDSOME DOME ABOVE THE MUSIC ROOM.



SKYLIGHT AND GALLERIES OVER THE DINING SALOON.