ENGINEERING.

It is probable that the four tunnels of the Pennsylvania Railroad Company between Manhattan and Long Island will adopt a track system consisting of treated red oak blocks, set in the concrete lining, on 20-inch centers. The blocks will be anchored to the concrete by expansion bolts; and the 100-pound rails, 60 feet in length, will be laid on 7-inch by 12-inch plates, 5/8 of an inch in thickness. The plates will be fastened to the blocks by two lag screws and the rails will be held down by clips and screw spikes.

The recent declaration of Prime Minister Asquith that in the future the British government will accept the two-power standard of naval strength as implying a preponderance by ten per cent over the two next strongest navies, has aroused no little interest in naval circles. If the "two next strongest navies" is intended to include that of the United States, which stands second in power to the British navy, the government is committed to a very large increase over its normal rate of construction, involving an additional outlay of from $25,000,000 to $30,000,000 annually.

A statement recently issued by the Pennsylvania Railroad Company shows that over $25,000,000 has been paid out by the employees' relief funds of the Pennsylvania Railroad system since their organization. Since July, 1889, on the lines west of Pittsburg, and since February, 1886, on the lines east of that city, over $15,000,000 has been paid to members who, because of illness or accidents, have been incapacitated for work. The remaining $10,250,000 has been paid to the families of members who have died.

Recognizing that the steel beams used in grillage foundations for tall buildings, because of their being concealed from examination, should be absolutely protected from corrosion, the firm of Milliken Brothers have been conducting experiments in the galvanizing of the beams after the shopwork upon them has been completed. By using the hot process in a large bath, they have succeeded in galvanizing not only I-beams, but a complete riveted-up steel column. Experimental grillages, containing galvanized steel, were broken open after they had been in the ground for six months, and the concrete was found to be in close and firm contact at every point.

The proposal to improve the efficiency of the steam-turbine propelled vessel by interposing electric generators and motors between the turbine and the propellers, is being made the target for much spirited criticism. Although it must be admitted that the higher speed of rotation which is necessary when a steam turbine drive is used causes some loss of efficiency, it has yet to be proved that the conversion of mechanical into electrical energy, and of the electrical energy back into mechanical energy, will not involve losses greater than those which it is sought to avoid.

The new Washington Street subway, Boston, which passes through the heart of the shopping district, is considered to be the most costly mile of underground railway in the world. Its construction and equipment has cost $10,000,000, or about $2,000 per lineal foot. The first section of Boston's modern system of rapid transit, consisting of subway tunnels, was opened about fourteen years ago. This was followed by the erection a few years later of the elevated road; and subsequently to that, the system was extended by the construction of the East Boston tunnel under the harbor. The opening of the Washington Street tunnel marks the latest, and one of the most important, extensions.

The next Congress will be asked to appropriate $11,341,730 for work in the navy yards during the coming year. Rear Admiral Holliday, Chief of the Bureau of Yards and Docks of the Navy, dwells, in his annual report, upon the pressing need for more drydocks, and for the construction of barracks at Philadelphia and Mare Island, capable of housing large numbers of men. The sum needed for the League Island navy yard is $721,500, and for the New York navy yard, $693,830, of which $300,000 is for work on the new granite and concrete drydock, which is to be one of the largest in the world. Admiral Holliday calls attention to the need for a drydock at Guantanamo, Cuba, to cost $2,250,000, and one at Pearl Harbor, Hawaii, to cost $2,000,000.

Speaking at the recent meeting of the Society of Naval Architects and Marine Engineers in New York city on the subject of the relation of the merchant marine to the navy, J. C. Butler, president of the Merchant Marine League, said: "To my mind, it is a disgrace to all of us that our huge battleship fleet, the pride of the nation, is convoyed and nursed around the world by a crowd of slow and shabby commercial hoboes, well named "tramps"—foreign colliers flying half a dozen foreign flags, cheaply built, with crazy hulls and rattletrap engines, and manned by the refuse of humanity. It is no wonder that these tramps have failed again and again to arrive on time, and to deliver their coal where it was expected and where it was required."

ELECTRICITY.

The use of electricity in construction work is largely increasing in this city. The current is utilized for the operation of electric hoists, pumps, and the like. The caisson work of a large new building is to be done with air compressors operated by electricity. Naturally, there is some apprehension of serious consequences, in case the current should fail while the work in the caisson is in progress, but special precautions will doubtless be taken to prevent any such accident.

A table giving statistics of single-phase electric railways in this country and in Europe has recently been prepared by the Westinghouse Electric and Manufacturing Company. According to this table, there are 28 roads (two still under construction) in America with line voltages ranging from 1,200 volts to 1,000 volts. Thirteen of the roads are equipped to use either direct-current or single-phase alternating current. The total number of locomotives used on these lines is 64. In Europe there are 34 single-phase roads using line voltages ranging from 500 to 20,000 volts, and they are equipped with 44 locomotives.

In order to determine whether electricity will convey any material particles with it when flowing through a conductor, Mr. J. Kinsky, writing in London Engineering, has made the following experiment: He took a cylinder of aluminium and placed it between two copper cylinders, subjecting the three cylinders axially to a considerable pressure. For an entire year current was passed through the series of cylinders, to see whether any particles of copper would be carried into the aluminium, or *vice versa*; 958 ampere hours were passed through the cylinders without the slightest evidence of any transfer of the metals.

Some interesting conclusions have been arrived at by the Swiss commission for studying electric operation of railways. According to this report, the maximum acceleration at starting should be 0.2 meter per second per second for express trains, 0.3 meter for passenger trains, and 0.1 meter for freight trains. The retardation should be 0.5 meter per second per second for passenger and express trains. The maximum speed of the electric train should be no greater than that now allowed, namely, 90 kilometers per hour (about 60 miles per hour) on trains with automatic brakes, and 45 kilometers per hour (about 30 miles per hour) on other trains.

An electric barometer has recently been invented, which depends for its operation upon the short-circuiting of a U-shaped carbon filament by means of a barometric mercury column. The filament dips into the top of the column, and as the atmospheric pressure increases, the mercury rises in the tube, cutting down the length of the exposed part of the filament, and thus reducing the resistance. As the mercury is also affected by temperature, a second filament and mercury column is provided. In this column the tube is sealed, so that the mercury will not be affected by atmospheric conditions. As the filament is more or less covered by the thermometric column, the resistance correspondingly varies, and this variation in resistance is introduced in the circuit of the barometric filament, so as to counteract the temperature variations in the latter.

A combined carbon-filament and mercury-vapor lamp is being introduced in Germany. The filament is inclosed in a U-shaped tube in which is a drop of mercury. The air in the tube is exhausted, and in its place an inert gas is introduced, to permit the conduction of heat from the filament to the mercury. The U-shaped tube is inclosed in a bulb similar to the ordinary incandescent electric lamp bulb. When the current is turned on, the carbon filament is immediately rendered incandescent and the mercury gradually vaporizes, increasing the light intensity to more than double the value of that of the filament. A maximum intensity is obtained in about five minutes. The lamp consumes from 1.5 to 1.6 watts per candle-power, and its life is from 600 to 1,000 hours. The light it yields is perfectly white, containing none of the blue-green rays of the ordinary mercury-vapor lamp.

The first popular application of electric heating for household use was in connection with the electric sadiron. Now there are a large number of heating apparatus in use, which are proving very successful for occasional use or in certain special circumstances, although not in the least competing with coal for ordinary heating purposes. In a paper presented at the recent meeting of the American Institute of Electrical Engineers by Mr. W. S. Hadaway, Jr., on electric heating, he estimates that one watt will heat one square foot of common radiator surface through 1.26 deg. F. The cost of a kilowatt-hour he places at 6.7 cents, and the cost of one steam-heating unit at 40 cents. On this basis, electric heating would be fifty times as expensive as steam heating. No doubt the time will come, however, when the current which is generated from heat at the power station can be reconverted into heat at the house with sufficient economy to compete with the coal furnace.

AERONAUTICAL AND AUTOMOBILE.

The Automobile Club of France has taken up the subject of aviation and announced $40,000 in prizes for aeroplane races next year. The French government has also appropriated $20,000 for aeronautics.

On November 18 Wilbur Wright, while teaching Capt. Gerardville how to operate the aeroplane, had an accident that might have resulted as seriously as did that experienced by his brother two months before, had it not been for the celerity and coolness of the famous American aviator. In the third flight of that day, the aeroplane had been aloft for 19 minutes, when the right propeller driving chain parted, and the propeller stopped. Mr. Wright shut off the motor immediately, and glided safely to earth. It is probable that the chain had become worn through constant rubbing in the guiding tube, until one of the rivets gave way.

The Aero Club of America is soliciting subscriptions from its members for the two gold medals which were voted recently to Wilbur and Orville Wright. These medals will be worth about $1,000 each, and will be commemorative of the flights executed both here and abroad this year. As Mr. Wilbur Wright has arranged to continue his experiments for some time in the South of France, it is probable that only his brother Orville will be able to attend the banquet of the Aero Club to be given the first part of next year, when the medals will be presented. The Wright brothers have also been awarded gold medals by the Aero Clubs of both France and Great Britain.

Dr. Alexander Graham Bell's Aerial Experiment Association is busily engaged conducting a test of Dr. Bell's tetrahedral-cell aeroplane, which he has constructed at his summer home near Baddeck, C. B. A year ago the late Lieut. Selfridge made a successful ascent in the former aeroplane of this type, which had 3,392 tetrahedral cells. The present aeroplane has 5,000 cells and a spread of 42.65 feet at the top and of 32.8 feet at the bottom. Its height is 9.84 feet, and its fore-and-aft length at the bottom is the same. There is an open space about 6 feet square in the center for the aviator and the motor. The machine will first be tested by towing as a kite above the Bras d'Or Lake by means of two powerful racing motor boats. The association is also experimenting at Hammondsport, N. Y., with a new aeroplane mounted upon two light canoes. It is believed that it will be possible to attain sufficient speed to rise from the water, which would be required of an aeroplane for naval use.

Two attempts have been made recently to beat the record for long-distance ballooning, but neither of them was successful. On the 15th ultimo a transcontinental race was to start from Los Angeles, but on account of adverse winds only one balloon, the "America," ascended. This came down a few hours later on the coast some miles south of Los Angeles, after having gone out a considerable distance over the ocean. The second balloon, the "United States," started the next day, and remained up one night in a vain attempt to get over the mountains. A descent was made the following day at Corona. On November 23 the "United States" ascended at 10 A. M., and succeeded in crossing the mountains and traveling a distance of 312 miles to within 15 miles of Ehrenburg, Arizona. The balloon passed high above San Jacinto Peak, which is a mountain more than 11,000 feet high. The trip was made at a speed of more than 50 miles an hour, and by it Capt. Mueller demonstrated that a transcontinental trip is a possibility. The second attempt at beating the long-distance record was made by the huge balloon owned by the London Daily Graphic. Carrying three men, this aerostat ascended from London on November 17, and descended in a gale near Novoalexanderovsk, Russia, the evening of the following day, after having traveled a distance of about 1,150 miles. The long-distance record of Count De la Vaulx (1,193 miles), therefore, was not broken.

The day before the Grand Prize race of the Automobile Club of America, at Savannah, a 198-mile race for small cars was run successfully. This race consisted of twenty circuits of a 9.8-mile course. There were 12 American cars, consisting of 1 Cameron, 3 Chalmers, 4 Maxwells, and 4 Buicks, while the Italians were represented by a Lancia and Isotta, and the French by an S. P. O. The S. P. O. dropped out of the race after completing four rounds, but the Italian machines ran fast and consistently, the Lancia finally winning in 3 hours, 43 minutes, and 33 seconds, an average rate of 52.6 miles an hour. Burman, in a Buick, was second some six minutes later, and a Chalmers-Detroit, driven by L. B. Lorimer, was third. A second Buick took fourth place, and Poole, on the Isotta, secured fifth. Two 2-cylinder Maxwells were six and seventh. Two other Maxwell runabouts were running in the eighth and ninth places when the race was called off. This race demonstrated very thoroughly the speed capabilities of the small car. It is remarkable that machines of one-fourth the power of the huge racers were able to maintain a speed but 12 miles an hour less than that maintained by the latter in a long-distance race.