THE ELECTRIC CAR EQUIPMENT OF THE LONG ISLAND RAILROAD.

BY W. N. SMITH.

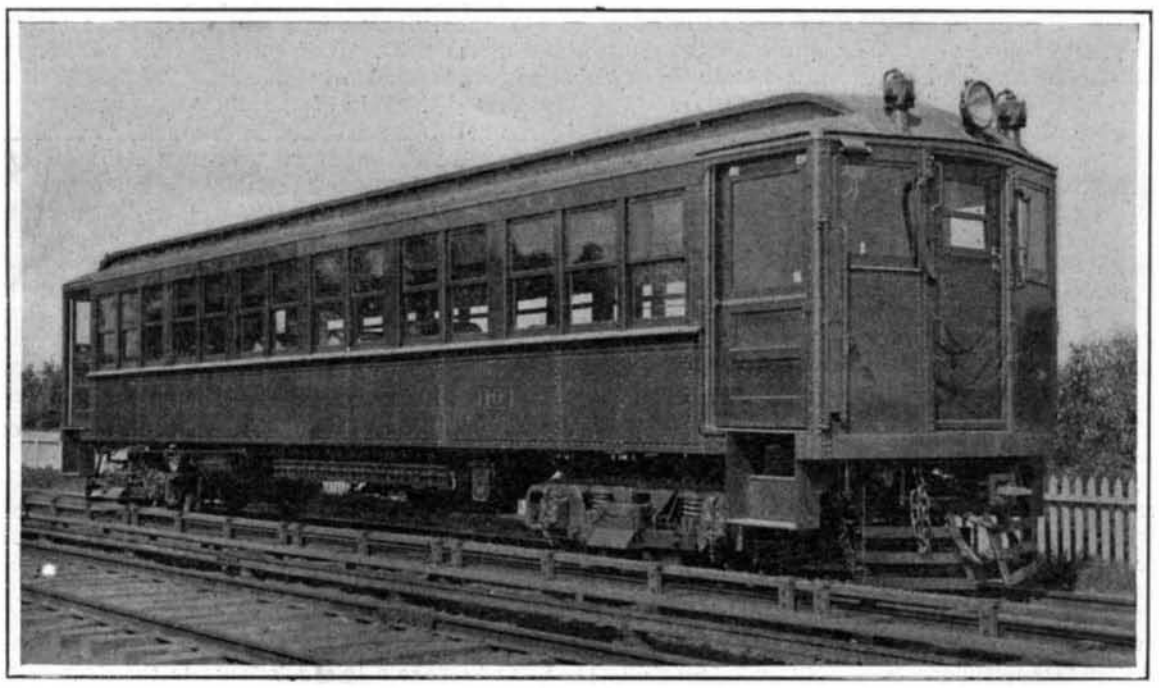
The design of the car equipment of the Long Island Railroad is based upon a careful study of the traffic conditions as they were outlined by the railroad officials at the commencement of the undertaking, calling for trains with the number of cars varying from two to six per train at different hours of the day in regular operation, while heavy excursion travel to the beaches and racetracks would, occasionally, require trains of ten or twelve cars. Some of the service is express and some local. It was deemed of the greatest importance to provide a single type of equipment that would be uniformly available for all the varying conditions of train service.

The maximum possible speed for express runs can be made when all the cars of a multiple-unit train are motor cars. Ordinary schedule conditions, however, usually permit a portion of each train to consist of trailers, and the most severe conditions of frequent stops can be met if the proportion of trailers is not more than one trailer to two motor cars. A considerable saving in the weight of the entire train is thus possible without exceeding either the tractive power of the motors or their ability to radiate the heat developed by the frequent accelerations which are the severest tax upon their capacity.

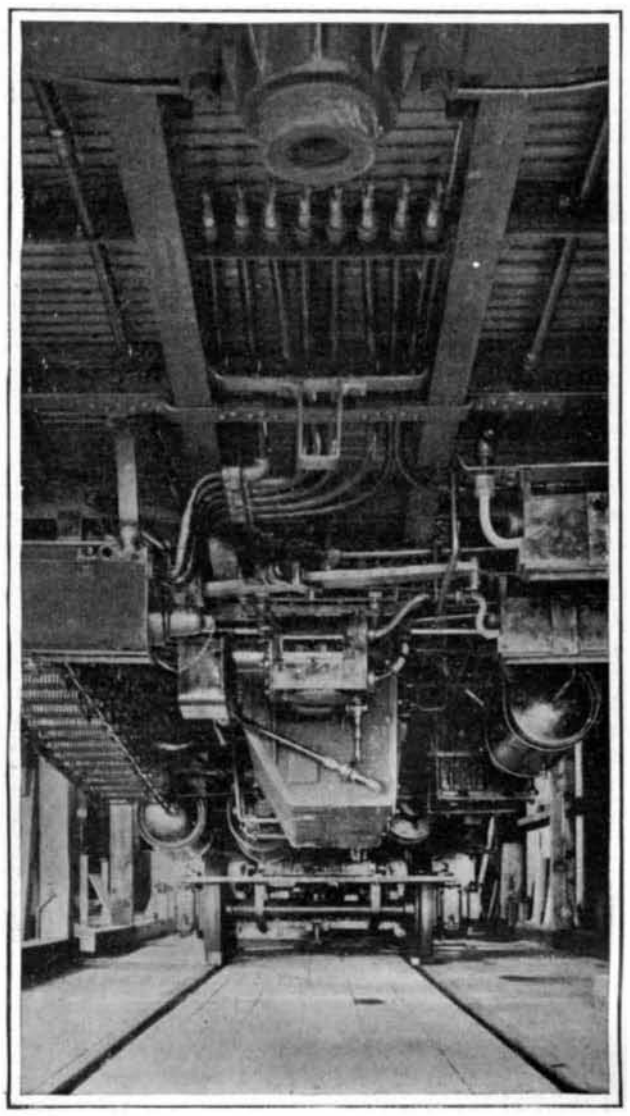
The fact that the Atlantic Division is partly in a subway and the need for interchangeability with the rolling stock of the Interborough Rapid Transit Subway has much to do with the design of the cars. The complete success of the first all-steel passenger cars ever built, and which were designed by Mr. George Gibbs of the New York Subway, led him, in his capacity of Chief Engineer of the Long Island Railroad electric conversion, to advocate their use on this road as well. To the Interborough Rapid Transit Company and the Long Island Railroad Company belongs, therefore, the distinction of being the first railroads in the world to adopt this radical departure in car construction, thus insuring to the public complete immunity from the danger of fire in cars equipped with apparatus carrying powerful electric currents.

The standard third-rail shoes on the Long Island cars are of the hinged slipper type supported on the usual wooden beam which is clamped against the notched face of the equalizer spring seat castings, providing means for vertical adjustment. Trains from the Brooklyn Rapid Transit Company's elevated lines operate over the Atlantic Avenue and Rockaway Beach Divisions by way of Chestnut Street Junction to Rockaway Park. The Brooklyn Elevated line has been for some years operated by the third rail, but the location of the rail is 22¼ inches outside and 6 inches above the track rail, while the Long Island Railroad third rail is 26 inches out and 3½ inches up. This made it necessary to devise some form of adjustable third rail shoe which would operate with equal facility over both third rails and be able to change from one to the other at reduced speed without requiring attention on the part of the motormen or train crew. Such an arrangement has been worked out and patents on it have been applied for by Mr. James C. Boyd. It consists essentially of a hinged slipper type of shoe, mounted upon a movable lug which is held in either position by means of coil springs and is actuated by an arm that engages with the stationary cam mounted alongside of the track in line with the third rail. The movement of the car past this cam in one direction changes the shoe from the inner to the outer low position, while a reverse movement of the car past the cam changes it from the outer to the inner raised position. These adjustable shoe equipments have been fitted to such cars of the Brooklyn Rapid Transit Company as are to operate over the lines of the Long Island Railroad.

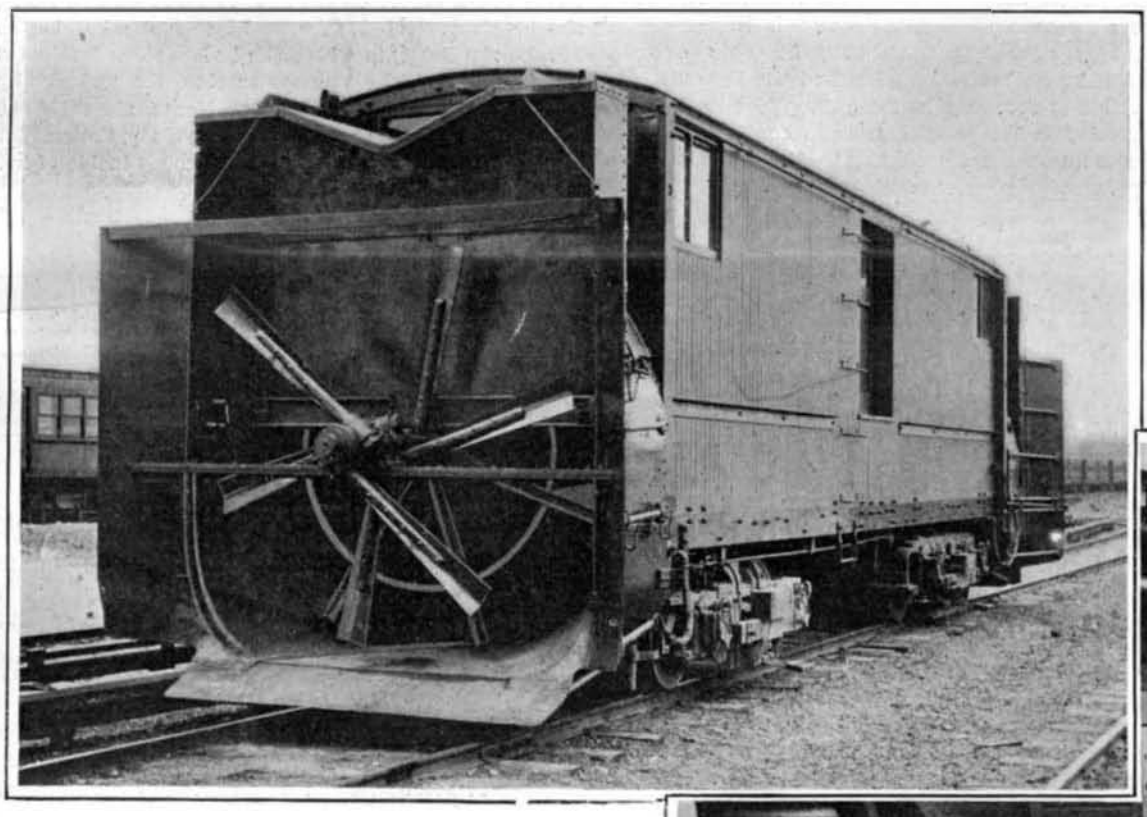
The cars are equipped with hand brakes and with the improved Westinghouse quick service automatic air brake. The quick service application is obtained by venting the train pipe air into the brake cylinders,



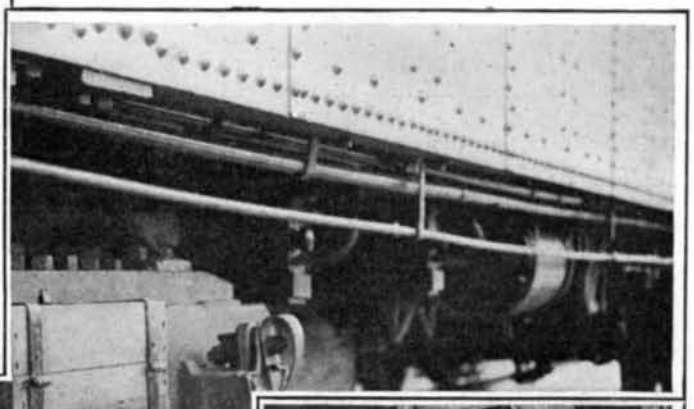
All-Steel Car Used on the Long Island Railroad.

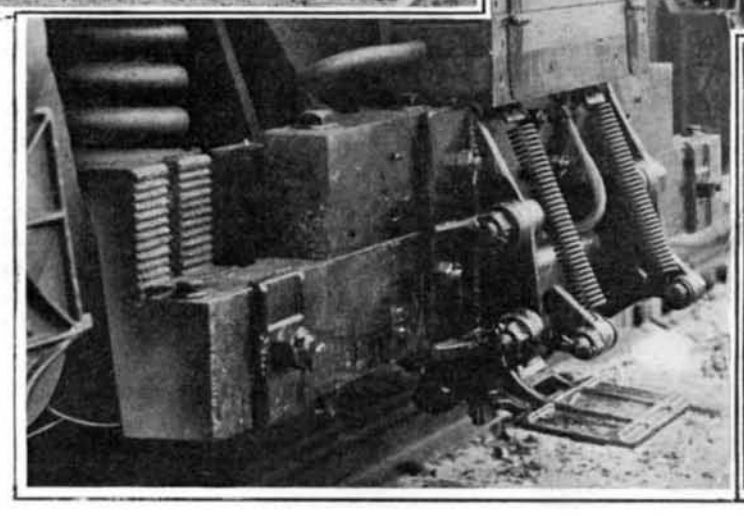


A Motor Car as Viewed from Underneath.

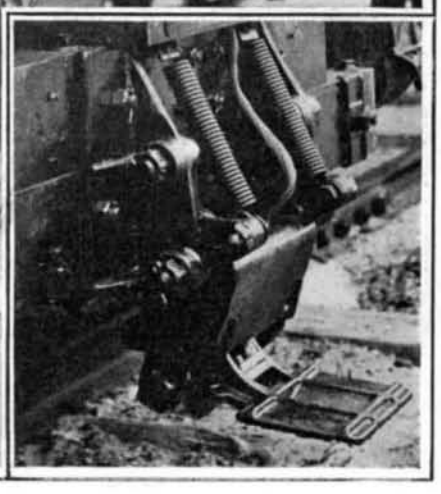


One of the Snow Plows.





Adjustable Third-Rail Shoe in Inner Position.



Outer Position.

in each service application, in the same way as is done in the quick-acting brake in emergency. The time required to fully set the brakes in service is, in this way, reduced approximately one-half, as compared with the usual apparatus. The cylinder pressure can also be gradually reduced by any desired amount just as with the old straight-air system. This is made possible by a special arrangement of ports in a triple valve and a partial release of the air from the cylinder is effected by slightly raising the train pipe pressure through the motorman's brake valve. The quick-charging of auxiliary reservoirs is done by providing an additional supply port in the triple valve connecting the train pipe on each motor car with the main reservoir through the feed valve. When the brakes are released the train pipe and auxiliary reservoirs are supplied from all the main reservoirs of the train, thereby permitting the auxiliary reservoirs to be charged at the rate that makes it practically impossible to deplete the effective pressure as long as the main reservoirs are supplied by the compressors.

The selection of the electrical equipment of the motor cars, whether operated singly or in trains, requires the most careful study of the loads to be handled, the schedule conditions under which the apparatus is to be operated, and the limitations of the apparatus itself. Whether all cars of a train should be motor cars; whether all axles of the motor cars should be equipped; what the motor characteristics, the ratio of gearing, and the wheel diameter should be; the maximum speeds that could be depended upon to make up time, and the amount of time to be allowed for "lying over" at terminals were, among others, considerations of the utmost importance in coming to a decision on the equipment that would most economically serve the purposes of the Long Island Railroad suburban lines. The variable number of motors and trailer cars per train caused some variation in the load per motor on different trains. There were also various classes of express and local service to deal with involving different schedule speeds and average lengths of runs between stops, for all of which it was desirable to provide a uniform equipment, so that any car could be devoted to any desired type of service without discrimination. Careful investigation showed that the greatest flexibility would result from two-motor car equipment, using the most powerful motors practicable. The limitations were mainly the dimensions imposed by the largest trucks that could be operated under the conditions prescribed by the tunnel and curve clearances which restricted the wheel base of the motor truck to 6 feet 8 inches. This restricted the size of the motor to about 200 horse-power and the study of the conditions was consequently reduced to an examination of the characteristics and gear ratio most suitable for this motor and of its power of endurance to resist overheating. At the outset a series of speed tests was made on various steam trains of the Long Island Railroad in order to compare the actual running time with that laid down in the time tables and with the times which the railroad officials desired to be met by the electrical equipment. An ordinary passenger coach was fitted with speed-recording devices, and a number of speed curves were obtained. These tests also threw some light on the time to be allowed for various delays to which the trains were likely to be subjected, and, together with the actually derived speed curves and calculated best performance curves, showed the relation between the schedule time ordinarily allowed for a train on a given run, and the best time that it could possibly make over the same distance. An idea of the scope of the problem may be had from the statement that there had to be compared about twenty-three different types of train runs, local and express, on eight different routes, with the average distance between stops different in practically every case.

The work of determining the equipment of any system, particularly one so extensive and interconnected as that of the Long Island Railroad, begins, therefore, with the railway motor performance as the principal starting point, and when the train requirements have been worked out carefully the determination of the rest of the equipment is a matter of detailed computation. The general fitness for its work of the equipment actually selected, as proved by the operating results, has justified the care that was taken to work out the problem in a consistent and logical manner.

The motors are of the Westinghouse type, both mounted on one truck. The cast steel frame is split at an angle of 45 degrees, horizontally, the axle bearing being in the lower half. The armature can be taken out without removing the motor from the truck by lifting off the top half of the frame, or the motor can be lifted entire from the truck by removing the gear case and axle caps. A nose suspension with safety lugs which engage with the truck transom is employed for this motor. Access to the brushes and brush holders is provided through an opening in the frame over the commutator, which extends down well over the axle making it easy to inspect the motor from the pit. The commutator cover is perforated, and openings in the bearing housings at the pinion end provide for ventilation, which is practically effected by air being drawn in at that end and thrown out through the ventilating cover over the commutator, forming a continuous draft through the motor.

The Westinghouse electro-pneumatic multiple control system was adopted for the cars of the Long Island Railroad. The advantage of air pressure as an actuating force for making and breaking switch contacts is that it permits an application of considerable power at the contact with relatively light and simple means consisting simply of a piston working in an air cylinder making contact by air pressure and breaking it by a powerful release spring when the air is exhausted. Contact is thus made certain and welding is prevented at the contact points with the very heavy operating currents that have to be carried. The use of storage battery currents for controlling the main switches removes the necessity for using line current at 600 volts in the control system, and further, relieves it from any bad effects that can result from a fluctuation of the potential on the system. The automatic feature of operation is of importance in securing a regular progressive action of the switches independently of the manner in which the motorman may handle the controller, or of any accident that may happen to the train line. The switches are moved only in a certain predetermined manner through a system of interlocks, and the operating current is limited to a certain predetermined amount insuring a rate of acceleration that is automatically kept constant, which results in maximum comfort to the passengers and a minimum of wear and tear.

THE RACE FOR THE KING'S CUP.

(*Continued from page* 112.)

inches. We give these dimensions for comparison with those of "Effort" to show, in a rough way, the effect of the new rule; for, although the "Weetamoe" is 9 feet shorter on the water-line than the "Effort," she has the same beam and 6 inches more draft.

Another new yacht that sailed for the cup, although she was built for cruising and lacked the lightness of construction of the racer, was the sloop "Irolita," built by Herreshoff. She is of composite construction, 65 feet water-line, 90 feet on deck, 18 feet beam, and 9 feet draft. She carries a centerboard for windward work.

There were altogether seventeen entries for the King's cup, and they ranged from the old cup defender "Vigilant," now rigged as a yawl, with a rating, under the new rule, of 92.20, down to the little sloop "Boris," with a rating of 48.40. That only nine out of the seventeen should have started is greatly to be regretted, for where all the yachts entered, as in this case, are the work of well-known designers and are properly handled by skillful skippers, professional or amateur, the interest in a race may be said to be directly as the number of entries. Moreover, the method of rating and handicapping is evidently a liberal one, and affords an excellent inducement to the smaller yachts to push through a long race of this kind and do their best to win. It is stated that the reasons that withdrawals were so many were two: first, that the day was thoroughly disagreeable; secondly, that in the rather fresh breeze that was blowing, many of the older and the smaller yachts considered that they had no chance to win. There was a time in yachting when owners were perfectly ready to cross the line in the interest of the sport, and sail their yachts for everything that was in them, even though they knew that the chances of victory were small. Moreover, it will be an unfortunate day for yachting when lowering skies and a dash of rain prove sufficient to keep one-half of our yachts at their moorings, especially on an occasion like this, when a famous trophy is to be contested for.

Of the yachts which sailed the race, the most famous, of course, is the yawl "Vigilant," a bronze boat built in 1893 to defend the America cup against "Valkyrie II." She is 86 feet 3 inches on the water-line, 126 feet on deck; her beam is 26 feet, and her draft 14 feet 5 inches. Next in historic interest to her is the "Corona," formerly the steel sloop "Colonia," built in the same year as "Vigilant" for the defense of the cup. She is 85 feet 6 inches on the water-line, 123 feet on deck, 24 feet beam, with a draft of 14 feet 10 inches. After the trial races in which "Vigilant" was selected, the "Colonia" which, as a sloop, had a tendency to make too much leeway when close-hauled, was provided with a centerboard and rigged as a schooner. For several years she has been the crack schooner of the New York Yacht Club, and only with the advent of last year's schooner "Elmina" and this year's "Queen" have her colors been lowered. The "Elmina" was built last year from the designs of Cary Smith. She is a steel schooner, 87 feet on the water-line, 125 feet on deck, with 25 feet beam and 15 feet 2 inches draft, spreading 10,000 square feet of sail. Another schooner which in her day was the fastest of her class is the "Amorita," a steel, keel-and-centerboard schooner, designed also by Cary Smith and launched in 1895. She is 70 feet waterline, 99 feet 6 inches on deck, 20 feet beam, and draws 12 feet of water. She is owned by Richard Mansfield, who was on board throughout the race. Another schooner that sailed the race is the "Muriel," a Cary Smith boat, built in 1901; 68 feet water-line, 99 feet on deck, 20 feet 5 inches beam, and 12 feet draft. The other two yachts were the famous twin 70-footers "Yankee" and "Rainbow," of composite build (wooden sheathing on steel frames) designed and built by Herreshoff in 1900. They are 70 feet on the waterline, 106 feet on deck, with 19 feet 6 inches beam and 14 feet draft. The "Yankee" was sailed by her owner, Harry Maxwell, and in this race, as in all of those that have preceded it throughout the season, this clever amateur was pitted against the veteran professional skipper Charlie Barr, who sailed the "Rainbow," which is owned by Cornelius Vanderbilt, the Commodore of the New York Yacht Club. In this race, as in many others of the season, Maxwell secured the lead over the "Rainbow." The twin sloops were making an excellent race of it when the "Rainbow" had the misfortune to strike an uncharted rock, shaking up her crew badly, and so severely straining the yacht that she had to be withdrawn from the race.

From a yachtsman's point of view, the conditions for the contest were excellent, though the day was cloudy, with showers of rain. There was an easterly wind of moderate strength, and the triangular course was adopted, giving first 16½ miles to windward, then a reach of 4 miles, and then a run home before the wind of 17 miles. The "Queen," which was sailed by her owner, J. Rogers Maxwell, took the lead soon after the start, and was never headed throughout the course. Although at times she was sailing 13 knots an hour and gained a long lead on the whole fleet, the event showed that she never pulled far enough away from the "Effort" to have the race safely in hand. She had to make a total allowance to the sloop of 20 minutes and 42 seconds. At the end of the 16½-mile leg to windward, she was 9 minutes and 10 seconds ahead of the other; on the next leg, a reach of 4 miles, she beat the sloop 3 minutes 35 seconds; but in the 17-mile run home, in which she had to allow 9 minutes and 15 seconds, she was faster than the "Effort" by only 6 minutes and 43 seconds. Hence, although she crossed the line far in advance of the sloop, the smaller yacht managed to get home just 9 seconds inside of her allowance, and take the cup. The second yacht over the line was the "Yankee," which, although admirably sailed, finished about 10 minutes astern of the big schooner. The third vessel in was the "Vigilant," and then followed the "Elmina." Next in their order to finish were the "Effort," "Corona," and "Amorita," the "Muriel" having withdrawn during the race. The summary of the race is given below:

Yacht.	Start. h. m. s.	Finish. h. m. s	Elapsed Time. h. m. s.	Corrected Time. h. m. s.
Effort	11 30 38	4 22 58	4 52 20	4 06 40
Queen	11 30 43	4 02 30	4 31 47	4 06 49
Elmina	11 33 12	4 11 18	4 44 06	4 20 35
Yankee	11 30 12	4 12 36	4 42 14	4 22 05
Corona	11 33 00	4 27 16	4 54 16	4 28 33
Vigilant	11 31 43	4 13 32	4 41 49	4 29 17
Amorita	11 31 18	5 02 18	5 31 00	4 43 27
Muriel	11 30 53	Withdrawn.		
Rainbow	11 30 25	Disabled.		

The "Effort" beat the "Queen" 9 seconds; "Elmina," 13 minutes 55 seconds; "Yankee," 15 minutes 25 seconds; "Corona," 21 minutes 53 seconds; "Vigilant," 22 minutes 37 seconds, and the "Amorita," 36 minutes 47 seconds.

The Current Supplement.

The excavation of the Pennsylvania Railroad station in New York city constitutes the subject of the opening article of the current SUPPLEMENT, No. 1598. An excellent drawing showing the scope of this vast undertaking illustrates the article. E. W. Wilgert gives some entertaining information on the first railway in America. Some good advice is published on gas-engine ignition. The last installment of Lieut. White's version of the battle of Tsushima Straits, based on information furnished him by men who took part in the battle, likewise appears. W. W. F. Pullen writes on chimney draft. Prof. Leduc has been engaged for some time in investigating the movements which occur in liquids under the influence of osmotic pressure, and the forms which result from a diffusion of the liquids in each other. The results of his experiments are described by the Paris correspondent of this journal. Some striking photographs accompany his text. Perhaps the most important article published in the SUPPLEMENT is one on the effect of the San Francisco fire on tall buildings of that city. The article is written by F. W. Fitzpatrick, a well-known authority, and discusses most exhaustively the effects of high temperature on various forms of structural material. Excellent illustrations elucidate the article. Another striking contribution is one on mosquito extermination in New York State, showing the various forms of experiments which have been used, and how marsh land has been converted into profitable farms.