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NEW YORK, SATURDAY, APRIL 27, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE LOCOMOTIVE OF THE FUTURE—A SUGGESTION.

The really remarkable rate of increase in the size and power of the modern locomotive, especially in the past four years, brings the locomotive-builder face to face with the question of making some very radical changes, if he is to satisfy the inevitable demand of the twentieth century for locomotives of greatly increased power and endurance. We recently illustrated a locomotive built for the New York Central Railroad, which showed a boiler capacity not far from double that of the celebrated No. 999 of the same road. The great dimensions of the boiler were rendered possible by the adoption of the Atlantic-type method of disposing the driving wheels, whereby the firebox may be extended to the full width of the loading gage. The diameter of the barrel, however, in locomotives of this type cannot be increased in proportion, the necessarily large driving wheels in express locomotives placing the barrel of the boiler so high that a restriction is put on its size beyond which it cannot go.

At the present juncture, then, we may reasonably ask whether, in view of the restrictions upon boiler space offered by the present method of carrying the engines and the boiler upon one frame, it would not be advisable to remove the engines and driving-wheels to the tender, replacing the present locomotive frame by a low frame or platform, designed simply for carrying a boiler of the full diameter allowable by the present loading gage. We have given the subject considerable study, and are satisfied that, as far as the tender is concerned, there are no structural difficulties to prevent the engines from being carried upon the same frame as the coal and water.

It is a common occurrence in the history of engineering for a device to anticipate the true era of its usefulness; witness Brunel's "Great Eastern," which was forty years ahead of its time, and is only now being equaled in size. The suggestion of engining the tender is not new; for between 1855 and 1860 Sturrock introduced, upon the Great Northern Railway, England, some locomotives which, in addition to the engines on the locomotive proper, had a set of engines carried beneath the tender. So great was the increase in hauling power that the device defeated its own ends, the sidings of the railroads at that day being all too short to accommodate the long trains of cars that these steam-tender locomotives could haul. Two other difficulties encountered by Sturrock were the fact that the dust and grit raised by the locomotive caused a rapid deterioration of the wearing parts of the tender engines, and that it was impossible in those days to provide a satisfactory flexible joint in the steam pipe between boiler and tender. The difficulties above mentioned would not be encountered in a present-day application of the system, the platform and siding space being ample, while the dust and grit difficulty could be overcome by running the locomotive tender first. Moreover, a three-joint ball-and-socket connection in the steam pipe might be used between engines and boiler; or, if this were found to be impracticable, it might be replaced by a large-diameter coil of pipe, made of steel of a high degree of elasticity. We are free to admit that this connection would probably be the most difficult problem in the design; but there is no reason to suppose that it would be beyond the possibilities of modern workmanship and materials.

By this separation of engines and boiler, it would be quite practicable to produce an express locomotive of from two and one-half to three times the power of the most powerful express locomotive existing today. In the first place, the boiler platform could be carried on two low, six-wheeled trucks, and by utilizing its full ten feet of width to carry a water-tube boiler of the Yarrow or some other first-class torpedo-boat type, and installing the necessary fans for forced draft, (the latter, by the way, a device tried as long ago as 1830 by Seguin on one of Stephenson's engines), it would be possible to provide three times as much heating surface as is found in the boilers of our largest express locomotives.

As to the utilization of this great steam capacity, the tender might contain two independent sets of engines, arranged on the Atlantic type system, with the cylinders carried over four-wheeled trucks at either end, and two independent sets of four-coupled driving-wheels between them. Such an arrangement, using blind drivers of 6 feet 6 inches diameter, with only an inch of clearance between them, could be accommodated on a rigid wheel-base not to exceed 31 feet. The decreasing weight on the drivers when the engine is running, due to the consumption of fuel and water, could be compensated by utilizing an adjustable fulcrum to transfer an increasing amount of weight from trucks to drivers. The coal space on the tender could be built with its sides and ends sloping to the center, after the fashion of a hopper-car, and a small bucket or screw conveyor could be arranged to bring a constant feed of coal from the bottom of the coal space up to the footplate of the boiler.

A water-tube boiler, built up to the full limits of the platform on which it was carried, would provide an ample supply of steam at 225 pounds pressure for two sets of the largest-sized engines that the adhesive weight of the tender would allow.

If the steam tender were provided with four 22 x 28 inch cylinders, and the maximum load on each set of coupled drivers were 110,000 pounds, the total drawbar pull would be about 60,000 pounds, or sufficient to haul a train of fifteen Pullman cars over a road of normal gradients and curvature at an average speed of 60 to 65 miles an hour. A common cab would do duty for the engineer and the two firemen, the arrangement being similar to that adopted on the well-known Fairlie type of locomotive.

As to the method of using the steam, it might be found preferable to expand it in three or four stages; but if the simple, high-pressure system were used, there would be the advantage that, the boiler being supplied with independent forced draft, the exhaust nozzles could be greatly enlarged and the back pressure reduced.

It will be seen, at once, that should the development of the locomotive follow along the lines indicated above, there would be a considerable increase in the total load on a given wheel-base, with the result that even our first-class roads would have to consider once more the question of replacing, or considerably strengthening, their bridges and track structures. This, however, will have to be done, in any case, before the locomotive of the present type has reached its limit of power and weight.

BEHR ON HIS HIGH-SPEED MONORAIL SYSTEM.

At a meeting of the Society of Arts, held last month, F. H. Behr read a paper upon his proposed high-speed electrical monorail between Manchester and Liverpool, which gives a better insight into the theories and aims of this indefatigable engineer than was obtained from any previous published account of the system. Mr. Behr states that he himself lays no claim to the propounding of the original idea, the credit due him being based upon his having developed the general ideas and principles of others in the designing of the practical details, and in having constructed monorails which have been worked successfully in carrying passengers and goods on a commercial scale for a number of years. He admits that the form of monorail which he has adopted was invented by Charles Lartigue, a French engineer, who constructed some primitive and simple lines in Algeria and Tiflis.

The first practical line built on the Behr system was a short length of passenger and freight railway in the north of Ireland. It was opened in 1888, and has been operated ever since without any difficulty or accidents. Another line was built on this system in 1893 in France as a branch line of the Paris, Lyons and Mediterranean Railway. Originally the inventor was impressed only with the advantages to be derived from applying the principle of the monorail to light railways in countries where the population was sparse, such railways to act as feeders to the main lines; but as electric traction became more perfected, Mr. Behr was impressed with the fact that an even more important application of the principle was to be found in the construction of high-speed railways.

The first experimental line designed to show the practicability of high-speed monorail travel by cars of standard size was built in the neighborhood of Brussels, as an annex to the exhibition of 1897. It was constructed under the auspices, and with the financial assistance, of the Belgian government; and although the electrical horse power furnished from the exhibition was only a quarter of the amount promised, and although over 75 per cent of the line consisted of curvature, a maximum speed of 70 miles an hour was obtained on the curves, on an elliptical track whose total length was about 3 miles. This structure consisted of a single rail, elevated 3 feet from the ground, and supported on A-shaped steel trestles. On each side of the structure were fixed two guide rails, 18 inches apart, whose duty it was to engage the thirty-two horizontal guide wheels which were provided on the car, and thereby prevent oscillation, and counteract the effect of the centrifugal force when rounding curves. The car was 60 feet long, 10 feet 10 inches wide, and weighed 70 tons. It was driven by 200 horse power electrical motors. During three months of the exhibition passengers were carried with safety at a speed of 70 miles an hour around curves of 540 yards radius. In the opinion of the Belgian government, the results obtained, considering the unsatisfactory conditions, were promising, and Mr. Behr was authorized to reconstruct the generating plant and make certain changes in the way of lightening the extremely heavy car. With a car weighing 59 instead of 70 tons, a speed was recorded of 83 miles an hour on curves of 540 yards radius, and it is considered probable that higher speeds than this were obtained for short distances. The report of these experiments stated that there was a marked absence of vibration, and it was thought that the results of the trial were such that, with a properly constructed generating plant, speeds of as high as 120 and 130 miles an hour could be obtained with absolute safety and at moderate expense.

The proposed line, for which Parliamentary sanction is being sought, will run from the city of Manchester to the heart of Liverpool. The trains will consist of single cars, with accommodation for from 60 to 90 passengers. The power station is to be located at Warrington, which is exactly half way, or 17½ miles from each terminus. According to Mr. Behr's calculations, he will require about 7,500 horse power to maintain this service at a maximum speed of 110 miles an hour, which speed is to be attained within 1¾ miles from the start. With a car accommodating 90 passengers the capacity of the line is estimated at 18,000 per day, although this could be doubled by providing a five-minute train service.

It is self-evident that the most crucial problem to be solved in a line of this kind is that of proper braking power. Mr. Behr relies upon experiments made with the Westinghouse brake, which prove that it is possible to apply a retarding force of 3 miles per second. That is to say, a train running at 60 miles an hour can be brought to a stop in 20 seconds, or in a distance of 360 yards. Behr believes that with the Westinghouse brake alone it will be possible to bring a train that is traveling at 110 miles an hour to a stop in 37 seconds, or in a distance of 995 yards. He proposes also to equip this railway with an electric brake as an auxiliary to the Westinghouse brake. After the current from the generating station is cut off, the current generated by the rotation of the motors is to be passed through a set of electro-magnets, thereby creating a strong magnetic field. There will be four magnets, each about 18 inches long, which will act on corresponding lengths of guide rail, the pull being equal to 200 pounds per square inch. The inventor considers that he can obtain this result with magnets each weighing less than 1,000 pounds. The combined effect of the Westinghouse and electric brakes is supposed to be sufficient to stop a train running at 110 miles an hour in 500 yards. The combination is only to be utilized in cases of emergency. The stopping of the trains is to be further assisted by a grade of 24 feet in 1,500 yards entering Liverpool, and a rise of 46 feet in 1,200 yards entering Manchester.

SUBMARINES FOR THE BRITISH NAVY.

After prolonged experiments and consideration, the British Naval Department have decided to construct five submarine vessels for the English navy. They are of the Holland type with some improvements carried out by their own experts, the exact nature of which, however, is not divulged. When presenting the Naval Estimates before Parliament the First Lord of the Admiralty remarked in connection with this latest acquisition to the fleet: "What the future value of these boats may be in naval warfare can only be a matter of pure conjecture, but the experiments with these boats will assist the Admiralty in assessing their true value. The question of their employment must be studied and all developments in their mechanism carefully watched by this country." From these remarks it is apparent that the English Admiralty, in view of the success that has attended the trials of this type, both in this country and in France, have at last realized that they are destined to play an important part in naval warfare of the future. The French are zealously following up the invention, and their latest experiments have resulted in a new use being discovered for the submarine. The storing of torpedoes upon a battleship is always attended with considerable danger, and the French naval authorities have been endeavoring to solve the problem by carrying the torpedoes in the submarines, and then taking the latter in tow by a battleship. The trials were undertaken with the "Gustave Zede," and it was proved that the submarine could be towed in this manner under water and submerged for several hours at a stretch.

Messrs. Vickers, Sons & Maxim have the British vessels under construction at their shipyards at