THE TUNIS MONORAIL SYSTEM.

Closely associated with the word "monorail" in the minds of the general public, there is doubtless a vivid picture of a huge car, a veritable hotel, balanced on a single rail by means of gyroscopes, racing at break-neck speed uphill and down, and now and then darting across a broad river or deep canyon on a slender cable. But the first monorail antedates Mr. Brennan's unique gyroscopic system by many years, and was based on principle with which engineers have long been thoroughly familiar. At the Centennial Exposition at Philadelphia, a "pack saddle" monorailroad was exhibited. The cars were bifurcated, and were mounted astride a single elevated rail. The balance was maintained by reason of the fact that the center of gravity of the cars lay below the track. Since then many other monorail systems have been invented. The Barman-Elberfeld line in Germany is an example of the suspension system, the cars being suspended from a monorail track, and it is the only monorail passenger line now in practical operation. Other monorail systems depend upon a guide rail to maintain the cars in upright position on the traction rail, and in this class belongs the monorailroad invented by Mr. Howard Hansel Tunis, which was exhibited at the Jamestown Exposition last summer. The Tunis monorail, although operated over a line scarcely half a mile long, proved to be a very popular feature of the exposition, and as a result of its success an elevated four-track high-speed monorailroad of this type from New York to New-ark is now being seriously considered.

The general features of the Tunis system are shown in the accompanying engraving. The traction or driving wheels of the car are arranged in tandem, and the cars are prevented from toppling over by an overhead guide. There are four double-flanged driving wheels to each car, and each wheel is driven by two electric motors. The details of these motors and their direct connection with the driving wheels are illustrated in one of our engravings.

The overhead guide is supported by a light framework, and consists of two parallel angle rails set with the horizontal flanges facing inward. Two X-shaped trucks with wheels at the four extremities of the X are mounted above each car, and engage the angle rails. The wheels are formed with grooves, $1\frac{1}{2}$ inches deep, to receive the horizontal flanges of the angle rails, so that the trucks, though free to travel along the guides, cannot be disengaged from them either by a dragging or a lifting force. Obviously, it is impossible to maintain the car at a uniform level below the guide rail, owing to slight variations in the level of the roadbed, as well as to flexure of the car springs; hence, the overhead trucks are mounted on short arms hinged to the roof of the car, in a manner similar to a trolley pole. The arms have a wide base, and effectually prevent lateral motion of the car with respect to the guide trucks, but allow perfect freedom of motion in a vertical plane. A coil spring pressing upward against each arm serves to counterbalance the weight of the arm and truck, and thus relieves the superstructure of all unnecessary strains. On a straight track there is little lateral pressure imposed on the guide rails. The cars are almost perfectly balanced, and as the principal weight due to the heavy motors is close to the track, the guide arms and trucks are furnished with a long leverage, so that the cars may be held upright by the merest touch. When the cars are in motion, the gyroscopic action of the trac-

tion wheels will assist in holding them in a vertical plane. So slight is the pressure on the guide rails, that it is proposed in future constructions to use a catenary suspension system for supporting the overhead structure. On curves the lateral pressure will

The Monorailroad at the Jamestown Exposition.

reach its maximum; but the strains will be materially reduced by leaning the cars inward to counteract the centrifugal force.

The guide rails are used as electrical conductors to supply the power necessary for running the motors. Evidently, the use of two conductors and eight guide wheels bearing upon them will provide a much larger contact surface than is possible in the ordinary trolley constructions, and it should prove a great advantage in reducing ohmic resistance. The problem of switch-

Details of Monorail Motor, Showing Method of Mounting on Driving-Wheel Axle.

ing the cars from one track to another is an interesting one. We are informed that a number of methods of switching have been worked out, which cannot as yet be disclosed, as they are still in the hands of the Patent Office.

It is claimed for this monorail system that it is far cheaper than a double-rail road. The roadbed is

graded to one-half the usual width, and in laying the track there is only one rail to deal with. This eliminates the difficulties of the double-rail track, in which each rail is dependent upon its fellow, both as regards gage and grade. It is a very difficult matter to preserve the two rails of a double track in absolute parallel with each other, and at exactly the same level or inclination. By doing away with this feature of the track construction, the cost of the superstructure in the monorail system will be more than offset.

The monorailroad is eminently fitted for high-speed travel, because the cars, being supported at the top as well as at the bottom, are kept very steady. We have reached the limit of speed on steam railroads. The violent rocking and swaying of the locomotive and the heavy pounding of its parts, work havoc with the track. Even with electrically-driven cars, a double track offers serious objections to high-speed travel. At the Berlin-Zossen high-speed trials a few years ago, a specially heavy and well-ballasted track was constructed; but the cars, when running over this track at speeds of 120 to 130 miles per hour, swayed heavily from side to side, and pounded badly at the joints, and developed enormous strains which, very evidently, would soon wreck the best of roadbeds. A slight depression of one of the rails is sufficient to start the car swaying, and at high speeds such swaying is not only injurious to the equipment and roadbed, but extremely dangerous to passengers as well. On the other hand, in a monorailroad of the type we have just described, the cars will have no tendency to sway, because a slight variation in the level of the rail will not result in a lateral motion, but merely in a vertical fall and rise.

A HIGH-POWER EUROPEAN LOCOMOTIVE.

BY CHARLES R. KING.

A locomotive recently built for the State Railways of Baden is probably the most powerful as yet constructed in Europe, and so is deserving of notice. The locomotive has 2,797 square feet of heating surface, generating steam with a pressure of 235 pounds per square inch and with a temperature of 570 deg. Fahr., utilized in four compound cylinders. The superheater is of the D or fire-flue type for high temperatures. The engine is of the balanced compound type, with all main rods working upon one almost perfectly balanced axle, the superheated steam being distributed by four piston valves. The constructive details of the boiler—with a wide firebox—follow the best American practice, and this with the bar-frame construction is entirely opposed to the reactionary opinions of engineers controlling the design of Prussian locomotives. Another feature to note is the method employed for connecting the inside main rods to the second driving axle. The impediment offered by the front connected axle is overcome by very considerably raising the inside cylinders and adopting a sharp inclination for the high-pressure pistons and rods. By this means all rods are contrived to drive the same pair of wheels. The crank axle is of the oblique-arm type, forged from an ingot of nickel steel of high tenacity and bored out hollow. There are no inside eccentrics to interfere with the strength of the crank webs. The inside high-pressure valves are actuated by two-armed rockers, there being only one set of valve gears for the four valves. The rockers move the valves through the same transverse planes simultaneously, consequently, while simple piston valves serve for the inside valves, triple-

The Most Powerful Locomotive Yet Built in Europe. Constructed in Bavaria for Use on the State Railways of That Country.

HIGH-POWER EUROPEAN LOCOMOTIVE.

headed double-ported valves permit of inside steam admission to the outside cylinders without resort to mechanical devices for reversing the simultaneous direction of one set of valves. A novel feature, for modern locomotives at least, is the employment of different lengths of piston stroke, the longest stroke being for the outside low-pressure cylinders. Mechanically, the engine is quite as simple as a single-expansion engine, the only added complication being that of the superheater in the boiler. To carry the valve mechanism, a special outside motion bar is introduced, supported at the front end on the valve cover, and at the back end on a beam of I section traversing the frames. The crank for driving the oil pumps, taking motion from the radius link, is carried on the outside of the motion bar. The long stem running from the reach-rod crank to the outside valve chests serves to pull back the small L-cranks on the stems of the vertical valves that are distinguishable on the low-pressure valve-chest casing, so that when the reversing gear is set to exceed a steam admission in the high-pressure cylinders of over 70 per cent, as in starting a train, the two cylindrical valves above the valve chest then open and permit superheated boiler steam to enter the low-pressure cylinders. Reduction of cut-off automatically closes the inlet valves. Water drain cocks are fitted to the cylinder, thereby indicating that highly superheated steam locomotive cylinders trap condensation water. All wheels of the locomotive are braked, the blocks on the driving wheels being disposed to reduce strain on the frame when they are applied. The general dimensions are: Cylinders, high-pressure, $16\frac{3}{4}$ inches diameter by 24 inches stroke; low-pressure, $25\frac{1}{2}$ inches diameter by $26\frac{3}{4}$ inches stroke; driving wheels, $70\frac{1}{2}$ inches diameter; boiler pressure, 235 pounds; inside firebox heating surface, 172 square feet; inside tube heating surface, 2,195 square feet; outside superheating surfaces, 430 square feet; total heating surfaces in contact with fire, 2,797 square feet; grate area, 48.4 square feet; weight of engine empty, 75 tons; weight loaded, 84 tons; weight on each pair of driving wheels, $15\frac{3}{4}$ tons; height of boiler center, about 9 feet 3 inches; height to top of chimney, 15 feet 3 inches; rigid wheel base, 12 feet 9 inches; and minimum radius of curves to traverse,

535 feet. The tender weighs only 21.8 tons empty, and carries 7 tons of coal and 20 tons of water. The tender trucks are of diamond pattern, the engine pilot truck having rolled plate frames, while the engine main frame is of bar type from end to end, without recourse to any form of mixed plate and bar construction.

The locomotive is required to work heavy gradients ranging from 16.7 to 20 per thousand, 22 miles in length, and on light grades of 1 in 300 to pull 300 tons and maintain a speed of 62 miles per hour.

According to a contemporary, a cement that will re-

A REINFORCED CONCRETE HOTEL.

BY DAY ALLEN WILLEY.

An interesting example of the use of concrete in building construction is given in several of the newer hotels in Atlantic City, N. J. This resort is on a flat, sandy island separated from the mainland by a marsh. The highest point is but a few feet above high tide and hard formation is at such a depth that most of the structures are supported on elaborate artificial foundations.

Trussed steel concrete has been successfully employed, and it is the method chosen in the erection

of the Traymore which is illustrated here. Considering its dimensions, the building was erected in remarkably short time, the exterior being completed in three months and five days. It has a frontage of 76 feet, a depth of 122 feet, and is nine stories in height, not including the massive dome, which contains three stories.

In preparing the foundation, piles were driven to a point below low-water level, and their tops were bedded in the footings of the concrete piers. The piers were built in sheeted pits kept dry by pumping until the first layer of concrete, inclosing the pile tops, had set. On this layer were placed two crossed tiers of Kahn reinforcement bars, above which the offset pier was built in the usual manner with monolithic concrete deposited in wooden forms. In the formation of the various supporting columns, the octagonal as well as the square shape is employed, the smallest dimensions being 10 by 10 inches in the upper story. In the basement the interior columns are 24 inches square, or are octagonal with minimum diameters of 28 inches. Both types are reinforced with eight vertical rods $\frac{3}{4}$ inch in diameter located in the middle of the octagonal sides or in the middles and at the angles of the square columns. In the latter the reinforcement rods are connected by $1\frac{1}{2}$ x 3-inch horizontal ties, 10 inches apart vertically. In the octagonal columns the reinforcement bars are connected by a spiral wrapping of $\frac{1}{4}$ -inch wire rod with a pitch of 3 inches, which makes a complete turn around every bar at every intersection. The wall columns are virtually rectangular piers, and, like the interior columns, their dimensions increase from the top downward until in the basement

The First Stages of Erection; the Molds in Position. This Picture Was Taken on October 2, 1906.

The Framework on November 16, 1906; the Molds Not Yet Removed on the Upper Stories.

The Structure Was Finished in Three Months and Five Days.

A REINFORCED CONCRETE HOTEL.

sist white heat may be made of pulverized fireclay 4 parts, plumbago 1 part, iron filings or borings free from oxide 2 parts, peroxide of manganese 1 part, borax $\frac{1}{2}$ part, and sea salt $\frac{1}{2}$ part. Mix these to a thick paste, and use immediately. Heat up gradually when first using.

The English Mechanic gives the following recipe for a compound good for cleaning paint on engines: To 1 gallon of water add $\frac{1}{4}$ pound of borax and $\frac{1}{2}$ pint of lard oil. Rub this upon the paint to be cleaned, then wipe off with clean waste or soft cloth. The wiping off must be done before the mixture dries.

onal with minimum diameters of 28 inches. Both types are reinforced with eight vertical rods $\frac{3}{4}$ inch in diameter located in the middle of the octagonal sides or in the middles and at the angles of the square columns. In the latter the reinforcement rods are connected by $1\frac{1}{2}$ x 3-inch horizontal ties, 10 inches apart vertically. In the octagonal columns the reinforcement bars are connected by a spiral wrapping of $\frac{1}{4}$ -inch wire rod with a pitch of 3 inches, which makes a complete turn around every bar at every intersection. The wall columns are virtually rectangular piers, and, like the interior columns, their dimensions increase from the top downward until in the basement