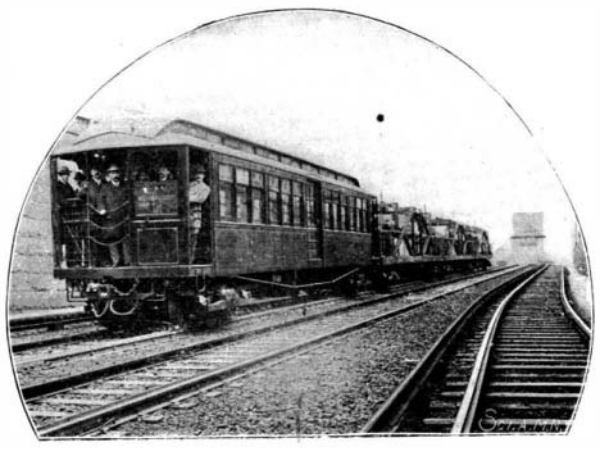
UNIQUE ELEVATED-UNDERGROUND STREET RAILWAY IN BOSTON.

BY J. A. STEWART.

Boston's new elevated railroad, soon to be set in operation, presents many features of interest, but none is so unique as its ingenious plan of connection between the new elevated system and that thoroughly approved construction—the subway. It is not every city that can run an elevated railway underground;



ACCEPTED TYPE OF CAR.

and this is what Boston is about to do. When the plans of the Elevated Railway Company, which, under the act of 1897, had been submitted to the Board of Railroad Commissioners, for approval, were examined by this commission, it was found that they rendered necessary extensive alterations at the Pleasant Street entrance to the subway, which would cut off all connection between the subway tracks and the surface tracks on Shawmut Avenue and Tremont Street.

ELEVATED COMPANY'S INCLINE, LOOKING NORTH TO SUBWAY ENTRANCE UNDER PLEASANT STREET.

The position taken by the company was that train service on the elevated road was practically a necessity; and that all surface cars from Shawmut Avenue and Tremont Street should consequently be excluded and the two outer tracks of the subway be devoted exclusively to the elevated service. The Boston Transit Commission, on the other hand, held that a new subway on Washington Street should be built to accommodate elevated train service. It was deemed inexpedient by them to adopt a plan of operation, or to make alterations in the subway which would prevent surface cars from entering it at the Pleasant Street terminal. It was proposed by the Transit Commission, with a view to providing for both the elevated and the surface cars, that the Elevated Company make connection within the subway with the tracks now devoted to the Shawmut Avenue traffic, which connection. it was claimed, could be made with but little expense and without material alterations of the company's plans for approach to the subway. Moreover, this would leave the connection with the two Tremont Street tracks unimpaired and ready for use at such time in the future as another and better route for the elevated road should be secured.

The plan of the Elevated Company, however, carried the day and won the unconditional approval of the Board of Railroad Commissioners. By its provisions the inbound elevated railway track is joined within the entrance to the subway with the present inbound Shawmut Avenue track, and the outbound elevated track is connected with the present outbound Tremont Street track, thereby doing away with all connection between the surface tracks and the subway.

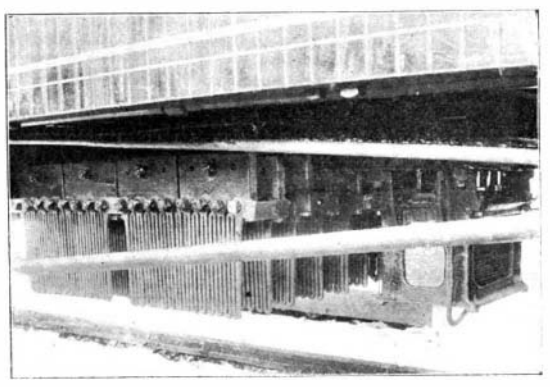
The Transit Commission has held that this plan involves a radical departure from the plan and purposes of the subway as originally designed. It is pointed out that the route for the subway selected by the Legislature was well adapted to a service of street cars running singly or in pairs, but that it was not so well adapted for a train service, for which a route with fewer curves and less severe grades would have been better. It is declared that the original charter of the Boston Elevated Railway Company, which formed part of the same legislative act which authorized the construction of the subway, did not contemplate the running of the cars of the company through the subway. The subway, it is claimed, was constructed to meet the requirements of surface lines only. As is well known, a large expenditure was incurred at the Pleasant Street terminal to admit the traffic of two tracks on Tremont Street, south of Pleasant Street, and of the two tracks on Shawmut Avenue to be consolidated on two tracks within the subway

RELAYING PIPES ON SURFACE STREET OVER THE ELEVATED.

without grade crossings. This expensive construction, it appears, has now been rendered useless by the alterations required to meet the Elevated Railway's plans.

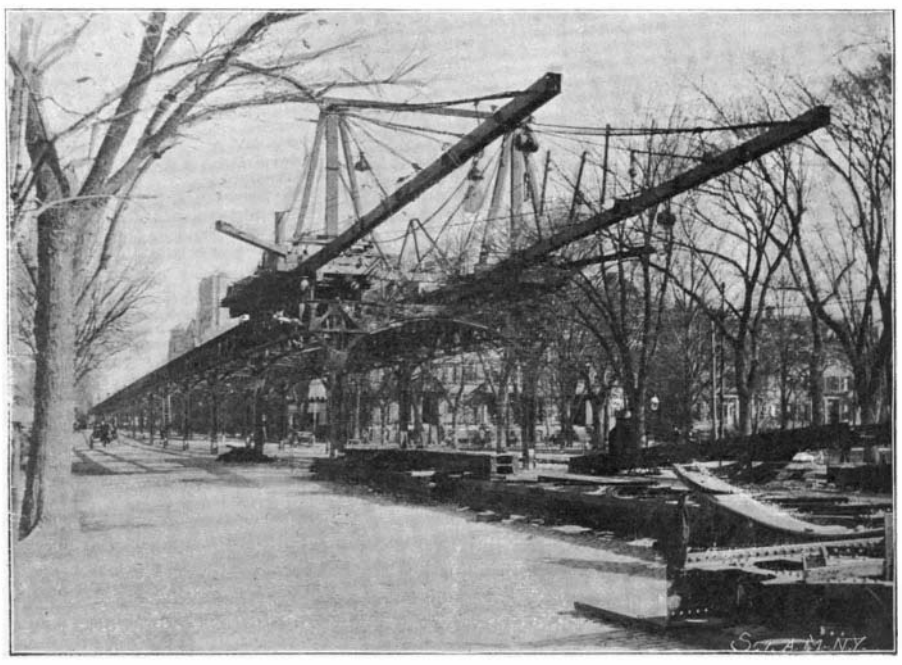
The work of making these changes has involved the taking out of the former incline which rose to the surface at Pleasant Street, the removal of two tracks, and the extension of the subway to a distance of about 40 feet under Pleasant Street, to avoid a grade crossing. This work has involved an expenditure by the city of about $300,000.

The Elevated Railway's route traverses Washington Street north from Dudley Street to Castle, turning west on Castle to Emerald Street, whence it describes a curve as it crosses the Boston and Providence and Boston and Albany Railroads. The tracks are supported on two substantial stone piers over the railroad crossing, and carried to a high retaining wall of masonry on the north side of Castle Street. A storage battery building, with 2,500 horse power to aid cars up the incline, is located at the head. The incline which leads directly into the subway is 540 feet long and 40 feet wide. It is built on private property, parallel with Porter Street, and is similar in construction to the subway. Its high masonry retaining walls are surmounted by a neat brick parapet. Its bed is of concrete on waterproofing, with the requisite drains. The gradient commences at 2.48 per cent; increases to 3.8 per cent at the curve, and after crossing Corning Street to 5 per cent.



RESISTANCE COILS UNDER CARS.

By the changes necessary to make connection be-



TRAVELER USED IN ERECTION.

CONSTRUCTION OF DUDLEY STREET TERMINAL.

tween the elevated and the subway, as has been stated, two tracks have been abolished in the subway between Hollis Street and Pleasant Street. The alteration also renders useless the sub-subway which was constructed at Boylston Street to avoid a grade crossing.

Moreover, the entire rearrangement of the surface of Pleasant Street has been rendered necessary. New sewer and water pipes have been built, as well as new surface tracks.

A unique transfer station will be located at the Pleasant Street terminal. Under the new order passengers on the surface line (which will run only to this point) will perform the paradoxical feat of descending to take the elevated.

At the Haymarket Street or north terminus of the subway, the convergence of underground and elevated has been comparatively a simple feat. In this case, the plans of Commission and company were coincident from the beginning, and no drastic change is involved. The elevated simply takes advantage of the slope already existing to run into the subway. Coming south over the new Charlestown Bridge en route from Sullivan Square the elevated train will turn west on Causeway Street, south again at Haverhill Street, to descend directly into the subway. There is no earthwork, but the steel superstructure will be maintained on pillars constantly decreasing in height at a practically continuous grade of 5 per cent. The north terminus will also have a transfer station to be composed of elevated station above and surface platform below.

The type of cars chosen by the Boston Elevated Company, as shown in our illustration, are fitted with the Sprague electric control and with Westinghouse motors. The elevated cars will move in trains of three to five cars, with complete motor equipment on each car; an arrangement that enables them to be run separately if required.

In order to facilitate rapidity, the plans approved by the Railroad Commissioners provide for only a very few stations. The surface cars will furnish accommodation for short distances. It is evident that unless elevated trains can run a considerable distance without a stop, there is no saving in time. As laid out, there will be a reduction of two-thirds of the schedule time.

Under the new regime of combination of subway and elevated, Boston's street railway patrons will travel faster within the heart of the city than they do upon its borders.

THE STEEPEST RAILWAYS IN THE UNITED STATES.

BY WALDON FAWCETT.

The New World enjoys the distinction of possessing the pioneer mountain-climbing road as well as the steepest. The line referred to is the railway which ascends Mount Washington, in the White Mountains, New Hampshire, the highest peak east of the Rockies in America. The Mount Washington road, the construction of which occupied the three years from 1866 to 1869, has the exceptional ascent of one foot in 2.67 feet. In point of steepness of grade the nearest approach in this country is the Pike's Peak Railway, another American mountain-climbing road, which has a grade of one foot in four. The Pilatus, the most nearly perpendicular of the European roads, has a grade of 48 in 100.

The trip to the summit of a mountain via a railroad equipped with modern safety devices is fraught with very little danger. Indeed, in the third of a century that the Mount Washington road has been in operation, not a single passenger has been injured. All the mountain-climbing railways in which American engineers take such pride are of the type known as the "cog road." The trains, each consisting of a locomotive, tender and one small passenger coach, run on three rails, two of the ordinary pattern and a "cog rail," in the center of which runs the cog wheel of the locomotive, thus propelling the train. The application of the cog principle to the propulsion of cars up an inclined railway was the invention of Sylvester Marsh, who had to undergo the vicissitudes that proverbially come to inventors. When, after months of work, he finally made a model of his proposed road and exhibited it to the New Hampshire Legislature, to which he had made application for a charter, one skeptical lawmaker sneeringly proposed giving him a charter for a road to the moon. It was eight years later that the first diminutive snorting engine reached the summit of Mount Washington, 6,291 feet above the level of the sea, and the achievement represented an expenditure of fully $150,000; but when the success of the innovation was assured, Swiss and German engineers hurried to America, and it was decided forthwith to adopt the principle in the construction of a road up Mont Riga.

The hump-back locomotives which drag the dumpy little passenger coaches up the great, rocky hillside are unquestionably the queerest appearing engines in the world. The first engine constructed, which, by the way, was one of the greatest curiosities at the World's Columbian Exposition, in Chicago, in 1893, had the upright type of boiler suspended on trunnions, as it was thought it must be kept vertical, but owing to the changes in grades, it would oscillate and form a dangerous opening in the footboard. Worse than all was the fact that there was no device for feeding water to the boiler, so that the only plan to pursue was for the train crew to fill it up before starting, go as far as they could with safety, and then let the steam down again and fill up the boiler from pails of water. Still, it was this certainly crude machine that demonstrated to the world the practicability of the mountain-climbing locomotive.

The engines now in use have the ordinary type of locomotive boiler, but are somewhat shorter owing to the steepness of the track. The boilers are set in the frames with the front ends a foot and a half lower than the back, so as to strike a medium between the flat and sharp grades. To eliminate all danger, all the locomotives have double driving shafts and gear. Not to burden the reader with a technical description, it may be explained that each of these iron horses has two pairs of cylinders, each pair being connected with a toughened steel crankshaft. The dozen teeth of the crankshaft bite against the sixty-four teeth on the main or driving axle. On this axle, too, is the main cog wheel, which meshes in the cog rail in the center of the track and sends the locomotive forward six feet at each revolution.

Like the wiry little burros which they have displaced, these bantam engines have wonderful power. Imagine a building 3,700 feet in height, if such a thing were possible, and a block of granite on the ground, weighing eighteen tons. If such a piece of stone could be lifted to that height in a little over an hour, the engineering world would stand aghast, and yet this is practically what each of these little locomotives does on every trip. At the steepest part of the Mount Washington road, the famed Jacob's Ladder, the track has a rise of nearly two thousand feet to the mile, and during a test on this part of the line a locomotive was found to transmit to the cog wheels more than five hundred horse power.

In coming down the mountain no steam whatever is used, gravity alone doing the work and the machinery holding back. The time consumed in making the trip from the base of the mountain to the summit is about one hour and fifteen minutes. At the beginning of the trip the passengers are all seated at open windows reveling in the bracing mountain air, but before the ascent is half completed the windows are all closed, for the atmosphere is decidedly sharp, even though the cities below are sweltering in heat. The mountain trains move very slowly, so slowly, in fact, that any person could easily step on or off the car while it is under full headway.

While not so steep, the Pike's Peak Railway, in Colorado, is of considerably greater length than its counterpart in the eastern part of the country, and carries passengers to an elevation of fourteen thousand feet, where in midsummer they are often caught in a fierce snowstorm driven by a fifty-mile-an-hour wind. The line up this most remarkable peak of the Rocky Mountains was first projected about sixteen years ago, but was abandoned. Actual grading commenced in 1889, and the golden spike was driven in 1890. The average grade is about sixteen per cent, although in places it is as steep as twenty-five per cent.

As in the case of the Mount Washington road, already described, there is fastened to the cross ties, between the rails, a unique type of rail, into the notches of which roll the teeth of a huge steel cog wheel, drawing the train forward, literally inch by inch, until the entire nine miles of the ascent is covered. The roadbed is from fifteen to twenty-five feet wide, and has been cut from solid granite. Nearly two hours is required to travel the length of the road in either direction, and that this form of mountain climbing is somewhat expensive may be appreciated when it is stated that the members of a farmers' convention which recently chartered the four trains or, in other words, six passenger coaches for a trip up Pike's Peak, paid $2,700 for the privilege.

Even the traveler making the ascent on this road would scarcely appreciate the amount of study devoted to the difficult problem of its construction by the best engineers and mechanics or the perils and hardships which attended the survey and the actual work of laying the metal highway. Camping out, climbing over mountains covered with fallen timber and jagged rocks, the occasional intense cold, terrible snowstorms often attended with high wind and the difficulty of getting provisions, made the obstacles to this undertaking almost insurmountable. A feature of the Pike's Peak line is that there is no trestle work whatever, the four short bridges being of iron, resting on solid masonry. To prevent the moving or sliding of the track—a contingency which is, of course, the remotest of possibilities—owing to its enormous weight and the effect of varying temperature upon iron and steel, nearly one hundred and fifty anchors are embedded into the solid rock or masonry at varying distances along the route.

The rack or cog rails are each less than seven feet in length and very heavy. The teeth were cut from the solid piece by machines especially constructed for the purpose. So particular were the constructors, that the contract for making these rails required that each tooth be within the fiftieth part of an inch of the specified size. On the Pike's Peak road there are two cog rails set a couple of inches apart. As in the case of the other American mountain-climbing railway, the locomotive pushes the car in ascending and precedes it when descending.

On the summit of each of the mountains reached by rail the United States government maintains an observatory and signal staion. The observatory on Pike's Peak is the highest in the country. The first building, erected in 1876 and which afforded the first signal officers shelter, is quite small and was abandoned in 1882 for the more commodious stone house built in that year under the direction of Chief Signal Officer Gen. William B. Hazen. At the summit of Mount Washington there is also a hotel, heated by steam, and capable of accommodating two hundred persons. It is frequently crowded to its capacity by the people who remain on the summit over night to witness the sunset and sunrise. On the summit of Mount Washington also is the office of Among the Clouds, the only newspaper printed on the summit of any mountain in the world. For more than a quarter of a century this novel publication has appeared regularly. Two editions are printed daily during the summer months in as complete a little printing establishment as a person could expect to find anywhere. The copies of the paper, which are to be mailed to all parts of the country, are taken down the mountain on "mail trains," sled-like vehicles which coast down the steep stretches of the mountain railway at terrific speed.

Automobile News.

Alfred C. Harmsworth, the London publisher, owns no less than eleven horseless carriages, eight being driven by gasoline motors, two by steam and one by electricity. He also employs a number of steam trucks for transporting magazines and newspapers from his various publishing houses.

The Automobile Club of America has taken up the subject of placing substantial signposts upon the leading highways. Automobilists, as well as others using the country roads, have complained for a long time about the lack of adequate signboard information. In many cases the old signs are allowed to decay or the information becme illegible. The State and county authorities do not seem inclined to give attention to the matter. It was unanimously decided by the delegates of various automobile clubs to erect signposts of a uniform character, pointing out clearly the best roads between the principal points. The signs are to be like those used in France, made of iron, and practically indestructible. The route from New York to Boston will first be provided with these signs. Other routes, such as those from New York to Albany and possibly from Albany to Buffalo, and those on Long Island, will probably be attended to first. It is hoped in a short time, with the aid of these posts, it will be possible to travel with ease from Niagara Falls to Boston.

One of the heaviest automobile vehicles which has yet been constructed in France is the great hauling wagon built for the Say sugar refinery, to be used between the works and the railroad stations. It is an electric vehicle, and has been built at the Postal-Vinay works at Paris; it made its debut last year at the automobile fête at Vincennes, and since then has made good service in hauling heavy loads. The average load of merchandise is 11 tons, and as the vehicle and accumulators weigh as much as 13 tons, a total of 24 tons is reached. The electric motor, of special design, develops 20 horse power at normal running, but for heavy pulls may reach as high as 40 or 50; its speed is considerably slower than for the ordinary electric automobile. The vehicle travels at an average speed of 3 to 4 miles an hour on level road, this being considerably greater than the mean speed made by horses in like case. Even on grades it has proved very efficient and powerful; in one case a test was made on the well-known grade of Corbeaux, reaching 10 per cent, and it climbed up without difficulty at a speed of 2 miles an hour. During the month the registering instruments showed a consumption of 200 amperes at 155 volts, making 31,000 watts, or 40 horse power. The Say refinery is quite satisfied with the new system, and estimates that the vehicle gives an economy of $4,000 a year over horse vehicles; this figure includes the maintenance of the accumulators.