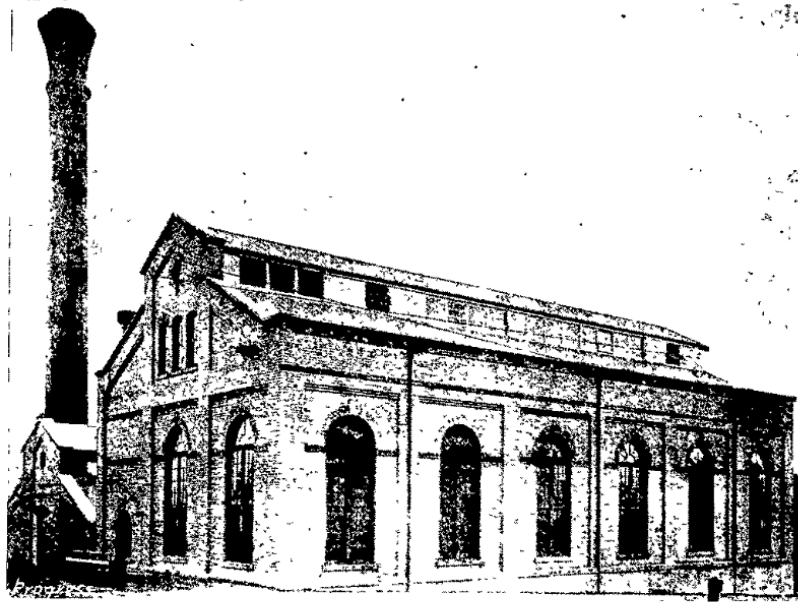


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ELECTRIC TRAMWAYS OF NEW ZEALAND
No. 4. - Auckland.



THE POWER STATION : SHOWING SELF-SUPPORTING STACK.

The Auckland Electric Tramways Company, Limited, was formed in March, 1899, to take over the existing horse tramways, with a view to their extension and conversion to electric traction. Under the laws of New Zealand no private promoter can apply direct for tramway powers; so, after protracted negotiations, the Auckland City Council applied for and obtained the City of Auckland Electric Tramways Order (No. 1), subsequently delegating their powers to the Company by a deed dated June 28th. 1900. In due course, the suburban authorities, ten in number, followed suit. The concession is for 32 years, after which time the local authorities may purchase the undertaking as a going concern, and confers upon the Company the exclusive right to construct and work tramways in the district.

The British Electric Traction Company, Limited, were appointed consulting engineers, and in July, 1901, contracts were placed with Messrs. J. G. White & Company, Limited, for the whole of the traction construction, overhead line, feeder system, and power station and plant. Subsequent contracts have been made with the same firms for the cars and the condensing system. The consulting engineers kept the construction and equipping of the car depots in their own hands. The track construction included in the present contract, and completed, consists of twenty route miles laid to standard gauge;

and the Company was enabled to instal double track throughout the routes where heavy traffic was to be expected. Furthermore, the clearway between the tracks is everywhere six feet, enabling centre poles to be used to a very large extent.

The rails used on the straight weigh 92lb. per yard. For the inner rail of each track, on curves of less than 300ft. radius a section weighing 95lb. per yard is employed. It was ascertained that 37ft. was the greatest length that could be conveniently shipped, and that was accordingly fixed upon as the standard length for rolling. The fishplates are 24m. long, weigh 52lb. per pair, and are fixed with six bolts. The rails and fishplates were manufactured by the Lorain Steel Company, the specified proportions of foreign elements in the rails being as follows:-

Carbon.	.45 to .55 percent.
Silicon	.04 to .08 per cent.
Phosphorus	Not more than .10 per cent
Sulphur	Not more than .085 per cent.
Manganese	.80 to 1.0 per cent.

The standard permanent way construction is as follows:—the rails are bedded about 1in. in longitudinal concrete sleepers, 18in wide by 9in. deep, and are edged on each side with one row of the local bluestone setts, laid serrated, or “hit and miss” fashion. Between the sleepers the road is excavated 9in. deep and filled in with macadam well rammed down.

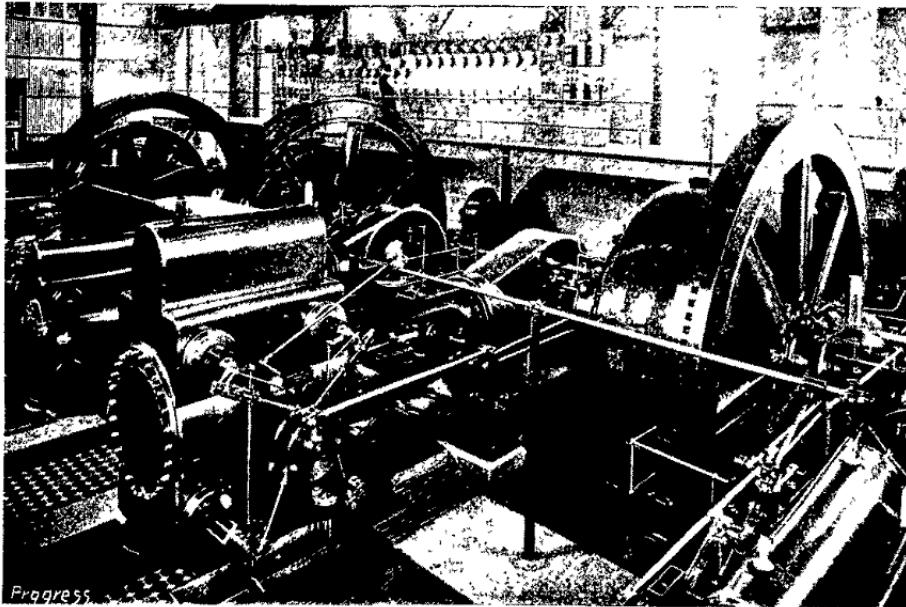
Another matter, of which mention may be made is the system of draining the track. As the rainfall at Auckland amounts to about 60in. a year it was felt that the drain boxes which have answered satisfactorily in England would not be adequate under these conditions, especially as the surface is macadam, and not setts. Accordingly, not only the rail groove, but also the whole width of the double or single track is drained. A narrow culvert with concrete bottom and brick walls is run across the full width of the track or tracks, a slot being cut out of the bottom of the groove of each rail to open into it, and is suitably connected with the nearest surface water drain or gully. The covers consist of stout iron grids, and an edging of setts is laid round the framework. One of these arrangements is placed at the bottom of each grade, the average distance apart being about three-quarters of a mile. All points and special work are also drained.

Coming to the overhead equipment, it has already been noted that centre poles predominate. Span-wire construction is used at curves and junctions, and in certain districts where the use of centre poles was objected to, as also on one or two branch lines. Side poles and brackets are employed to a limited extent. In fact, every variety of construction is to be seen, both with iron and wood poles, the latter being permitted in outlying districts. Swivel trollies are used on the cars, and the overhead work is arranged for maximum outreach of the trolley arm of 4ft. 6in., it not being considered advisable to exceed this amount with the speed of 10 to 18 miles an hour at which the cars run. All centre poles are provided with cast-iron wheel guards to prevent accidents to vehicular traffic, and, as an additional precaution, are painted white for six feet above ground. In the principal street the poles have ornamental bases. All poles, both iron and wood, are 32ft. long overall. Three grades of iron poles are used, weighing 905lbs., 1,295lbs. and 1,435lbs. respectively. The wood poles are of totara, and are square in form, and tapered 1 1/2 in. side at bottom to 8in. at the top. All wood poles are thoroughly tarred at the bottom seven feet.

The trolley wire is No. S.C. B.S.G., and flexible suspension is used throughout. The hangers are of galvanised malleable iron. The same regulations as to guard wires apply as in England, but, in addition, the Company was required to insulate all telegraph and telephone wires crossing its lines. The work in carrying out this proviso, and in raising the telegraph and telephone wires along the routes where centre poles were not permitted, has been considerable. Outside the central quarter, where cables have been laid underground, the feeders, consisting of 3, 4, and 6 bare copper wires of No. 4/0 B.S.G., are carried overhead on wooden cross arms affixed to the poles. The telegraph and telephone wires are carried overhead on little brackets.

The configuration and extent of the lines, and the heavy traffic, have made necessary an elaborate system of feeders. As far as possible, these have been carried overhead, but elsewhere cables insulated with vulcanised bitumen and manufactured by Callender's Cable and Construction Company, Limited, have been drawn into earthenware ducts. The ducts are all single way and octagonal externally, measuring about 4.5in. across, and having 3.25in. diameter bore. They are supplied in 18in. lengths and have been laid in what is known as the "Camp" system. The ducts are grouped together with a thin film of cement mortar between each, and the whole is surrounded with concrete uniformly 4in. thick, making a very strong and watertight construction.

The manholes are placed on the average 90 yards apart, and are of two sizes, 4ft. by 4ft. internally by 5ft. deep, and 2ft. 5in. by 3ft. 5in. internally by 3ft. 6in. deep respectively. Only one size of iron frame and cover is used, however, the upper brickwork of the large manholes being racked in to the required extent. The cover is recessed and filled with asphalt to a depth of 2in. The ducts are laid with a slight fall so as to drain into the manholes, and, where the accumulation of water would be likely to be considerable, a connection is made between the manhole and the nearest sewer.



THE POWER HOUSE : SHOWING CORLISS ENGINES AND GENERAL ELECTRIC CO.'S GENERATORS.

Four boosters, each consisting of a shunt-wound motor direct coupled to a series-wound generator, manufactured by the General Electric Company, of Schenectady, U.S.A., are provided in the power station. It was calculated that there would be required on the negative side one booster to give 20 volts at 400 amperes, and two giving approximately 110 volts at 330 amperes, and on the positive side one booster to give 105 volts at 250 amperes. It was desirable to make the last three machines interchangeable, and this was accomplished by selecting generators of capacity of 125 volts at 330 amperes, which would give at a lower load 105 volts at 230 amperes. Shunts across the fields of two of the machines reduce the pressure at 330 amperes to 110 volts. The specified maximum variation at any load from the straight line characteristics required for the generators is 8 per cent, of the voltage at that load. The power station is in two bays, each roughly 53ft. wide and 104ft. long, and is of the usual construction- brick walls over a steel framework. The roof is of corrugated iron, laid over 1.25in. boards.

The plant at present comprises:-

Four Babcock and Wilcox boilers, each of 2,100 sq. ft. heating surface, provided with Babcock and Wilcox chain-grate stokers.

One Green's economiser of 360 tubes.

Three engines, made by Cole, Marchent and Morley, Limited, of the horizontal cross-compound Corliss type, each capable of 475 i.h.p. normal and 700 i.h.p. maximum output, running at 100 r.p.m., with steam pressure at the stop valve of 150 lbs, per square inch. The specified maximum steam consumption at full rated load, working condensing, is 14.51bs. per i.h.p. hour, and the minimum mechanical efficiency at the same load 90 per cent. The permanent speed variation from the mean speed does not exceed 2.5 per cent., or the temporary variation 4 per cent., when the load is altered under working conditions.

Three 300-k.W., 8-pole, direct-connected, continuous - current, compound - wound railway generators constructed by the General Electric Company, and capable of 50 per cent, overload. The specified efficiency at full load is not less than 93.5 per cent. These generators are without shaft or bearings, the armature being pressed on to the engine shaft.

One 600-k.W. set constructed by the British Electrical Engineering Company; the engine, made by the same Company, being capable of 1000 i.h.p.

One 25-k.W. auxiliary unit, manufactured by the General Electric Company.

Four boosters already mentioned.

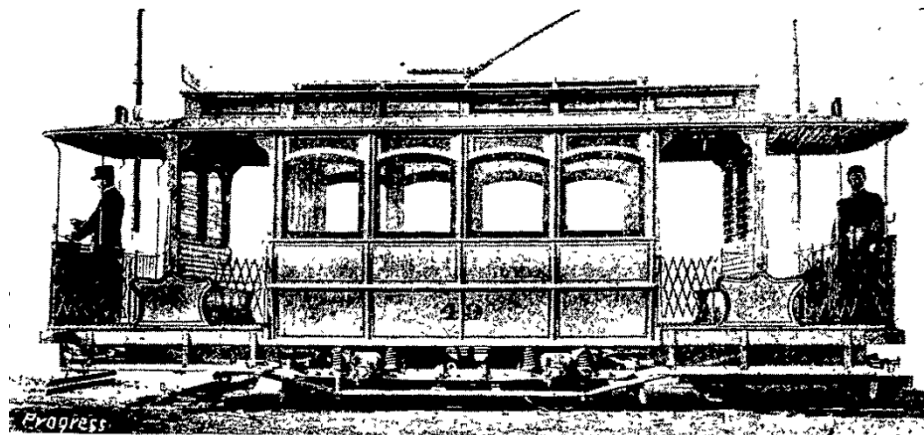
Switchboard, consisting of three generator panels, one load panel, one Board of Trade panel, four booster panels, six feeder panels, one lighting panel, and spare panel, made by the General Electric Company. The panels are of blue Vermont marble, held in a riveted steel frame. The board is of the flat pattern, with back connections.

One 20-ton overhead travelling crane, operated by hand from the ground, constructed by Higginbottom and Mannock. Piping, feed pumps, injectors, filters, hot well, tank, etc. etc. The feed pumps and economiser scrapers are electrically driven.



DOUBLE-BOGIE CAR BUILT BY THE BRUSH ELECTRICAL ENGINEERING CO.

The rolling stock consists of : 55 passenger and one freight cars, all constructed by the Brush Electrical Company, Limited, with the exception of one built by Messrs. Cousins and Atkin, Auckland. The single-deck bogie cars are of the combination type with closed centre and open ends, and are designed to accommodate 48 passengers ; the double-deck cars have reversed staircases and four motor equipments, and will seat 80 ; and the four-wheeled cars are divided into two compartments (one intended for smoking) with seats for 32. The bogie trucks are all equal-wheel, with wheel base of 4ft. In the double-deck cars each truck carries two motors, and in the single-deck bogie cars one motor, provision being made in the latter case for a second motor being added at any time. The wheel base of the single truck is 6ft. 6in., and it is, of course, fitted with two motors. The radius of the sharpest curve is 40ft. to the inner rail.



SINGLE-TRUCK COMBINATION CAR BUILT BY MESSRS. COUSINS AND ATKIN, AUCKLAND.

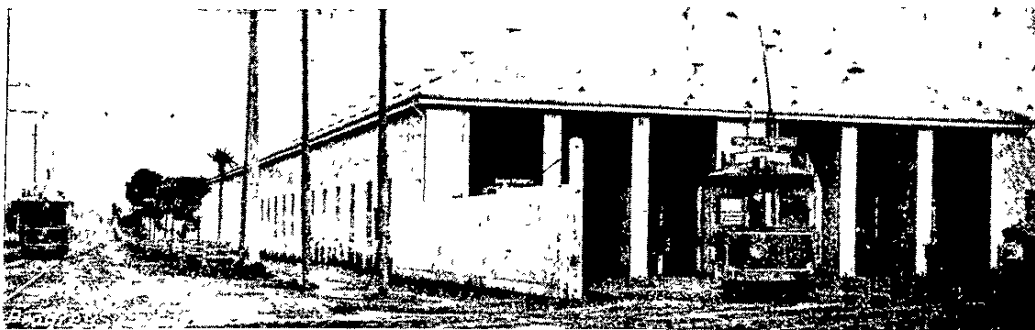
The wheels are of 30in. diameter. In view of the high speed at which the cars run at times, it may be suggested that 33in. wheels would have been more

suitable, but, on going carefully into the question, it was found that the use of 33in. wheels would entail the platform step being inconveniently high, and this idea was accordingly abandoned.

Each car is fitted with a hand brake, a track brake, and an electrical emergency brake.. The track brake is of the Spencer pattern, two slippers being fitted on each truck, and is so designed that a pressure of 4000 lbs. can be readily applied to each slipper without undue exertion on the part of the operator. The grades are very severe on some of the routes, the steepest about 200 yards in length, averaging 1-8.8, and there are longer grades of 1—11. Efficient brakes and ample motor power are, therefore, both necessary.

One standard size of motor, rated at 40 b.h.p., has been adopted. The maximum tractive effort specified was 1,700lbs. at the wheel tread, and the maximum car speed 18 miles an hour, the gear ratio being 14.68.

Each car is fitted with two life-guards of the “ trigger ” type. The trigger is a hinged frame under the front end of the platform, which, struck by anybody, releases the catch by which the guard is normally held up clear of the track, and allows it to drop down to receive the body and carry it along until the car can be stopped.



THE CAR SHEDS AT PONSONBY.

The Company owns two car depots, conveniently situated, which have been reconstructed and electrically equipped to accommodate 44 and 30 cars respectively.

The principal building is in two bays, 354ft. and 328ft. long respectively, and each 39ft. wide, containing the car-shed, paint shop and erecting shop, There are six lines of track in the car shed, all with pits under their whole length A third and smaller bay contains the machines, wood-machine, and blacksmith's shops, winding-room, stores, etc. A cross-pit connects the machine shop with the car-shed. Light rails are laid along the floor of all the

pits ; with turntables at the junctions with the cross-pit : and. with the aid of wheeled hydraulic jacks parts requiring repair can thus be transported from under the cars to the shops with the greatest facility. The tools, etc., in the repair shops include a 30-cwt. overhead travelling crane, 15in. and 8in. lathes, one heavy and one light drilling machine, a 150-ton hydraulic wheel press and an Allday's patent " Climax " hearth and blower. The lathes and drilling machines are electrically driven. For lifting the cars bodily a car-lifting appliance of 15 tons capacity is provided, consisting of two pairs of screw jacks on wheels and two girders.

In concluding this article mention should be made of the fact that the 1904 profits handed to the Auckland City Council by the Tramways Company amounted to £2,300, in addition to £1,200 paid in street rents and rates.

The results of the first and second years' workings are as follows

1903.	
Total car mileage run.....	1,318,469
Number of passengers carried.....	13,535,611
Total receipts.....	£82,929
Dividend.....	4½%
1904.	
Total car mileage run.....	1,702,173
Number of passengers carried.....	18,045,703
Total receipts.....	£112,429 9 7
Dividend.....	6%

(Searchable PDF version prepared by David Hyde - pseudonym 'David de la Hyde')

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