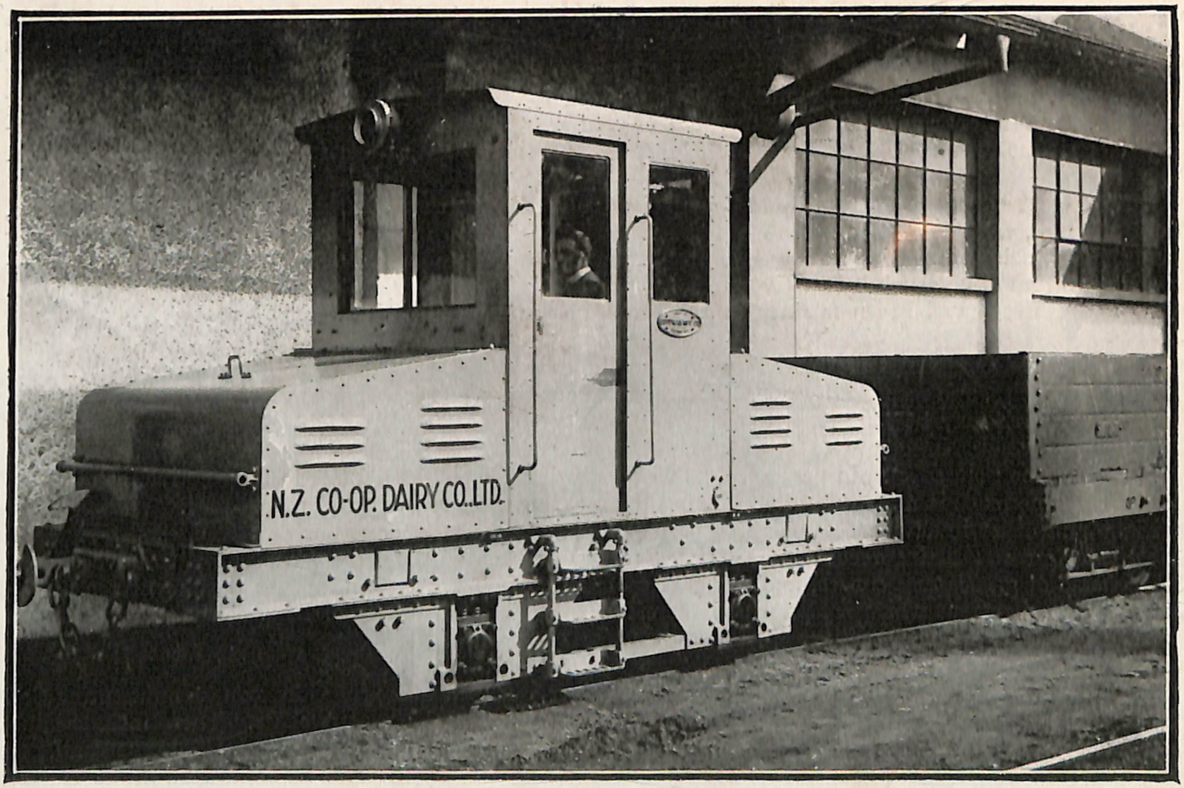
Bulletin No. 105

A. R. HARRIS COMPANY LIMITED

ELECTRICAL AND TRANSPORTATION ENGINEERS. CHRISTCHURCH, N.Z.

EDISON-GOODMAN
ELECTRIC STORAGE BATTERY LOCOMOTIVES

IN NEW ZEALAND



Edison-Goodman Electric Locomotive supplied to the N.Z. Co-op. Dairy Co. Ltd. Frankton Junction Railway Sidings.

As a substitute for the Steam Engine on shunting and short-haul work many industrial concerns in other countries are now using the Storage Battery Electric Locomotive.

The conditions of this short-haul work, the limited speeds, the frequent stops and starts, and the intermittent nature of the duty, reduce the efficiency of the steam locomotive to its lowest possible limits. Although up till the present time it has been very generally used in New Zealand, it is as ill-suited for this work as it is well suited for the longer distance and higher speed haulage. Moreover, the noise and dirt occasioned by prolonged steam shunting is a nuisance which has only been tolerated through custom and lack of any better method.

As an alternative to steam locomotion some of our Freezing Works and others have tried horse haulage, but here again, the horse, as a power unit, is not well adapted to the requirements of these services. The hauls are occasionally too heavy, the wear on the track is too severe, the cost of maintaining horses, stables and drivers is high, and the inconvenience inseparable from horse methods, especially when occasional hauls are required during night hours, is a considerable drawback.

It will be found that these conditions which militate against the use of both steam and horse traction are the very factors which emphasise the virtues of the Storage Battery Locomotive. The working radius of the Storage Battery Locomotive is restricted to comparatively narrow limits on account of the increasing cost for power storage along with an increasing demand for greater radius. Hence there is a certain distance limit beyond which the storage battery locomotive is not intended for service. But up to this limit (the power storage problem diminishing proportionately to the proximity of its working field) the Electric Locomotive is in its correct sphere and may be operated cheaper and more advantageously in other ways then either steam or horse power units.

It is noiseless and clean. Its pulling capacity is high. It is simple and flexible in control. It is a one man unit. It may be operated by a novice without license and without any special training. It is convenient in as much as it is always available for duty, day or night, without any preliminary " getting up steam," and its fire risk is practically nil. It gives no bother in the way a steam locomotive does for repairs and maintenance, working continuously if need be, with no more attention than is given to the average electric motor, and to the Edison Storage Battery as employed in other forms of electrical transports.

These outstanding features should be sufficient to predispose those controlling mines, railways, docks, and wharves, freezing works and other factories to be interested in the Electric Locomotive as offering the simplest solution to their rail haulage problem, and to these we have pleasure in addressing the following description of one such locomotive recently supplied by us to the New Zealand Co-op. Dairy Co., Ltd. The locomotive may be seen working at the Frankton Junction factories of this Company.

From those Companies or Gentlemen who are interested in this form of haulage, we cordially invite further enquiries, and respectfully offer the services of our Engineering Department on any electric traction proposals which may be submitted to us.

It may be pointed out, in passing, that with regard to all proposed Electric Locomotive installations care and experience is required in determining the most suitable equipment for each case. Working conditions and other involved factors are so variable that we prefer to have our own engineers review all details before submitting recommendations. Such matters as weights, draw-bar pulls, tractive efforts, the effects of grades and curves, and the choice of the correct battery and motor equipment are fundamental considerations which are prior and therefore prime determinants in arriving at the ultimate design and the price of the Locomotive.

In types and designs we have a large variety to offer, our principals, the Goodman Manufacturing Co., having evolved from their long experience, special models for special requirements. These include haulage or winding (" gathering ") attachments; trolly-pole locomotives for overhead working; and, to meet the requirements in certain cases where it is desirable to electrify the main line and work the subsidiary or any temporary lines from the Battery power, combination trolley-pole and Storage Battery locomotives are available. Models in all these may be supplied to suit existing track gauges.

A. R. HARRIS COMPANY LIMITED,

TRANSPORTATION DEPARTMENT.

10 Dundas Street,

Christchurch, N.Z.

General Description

The illustration shows the general appearance of the Locomotive supplied to the New Zealand Co-operative Dairy Company Limited, Frankton Junction.

Some of the features of the design are given below :—

CHASSIS.—The main frame is built up of heavy steel shapes, fully braced and riveted together to form a sturdy locomotive which will be satisfactory in very rough service. To these heavy channel side bars, liberal steel pedestals are riveted. The lower ends of these pedestals are strongly braced with channel iron, extending between pedestals and from pedestal to underside of channel side bars. This construction is just as strong as solid side plates and yet is open enough to permit quick inspection and easy re-railing. Cast steel axle boxes ride in these pedestals and are prevented from dropping out by means of a heavy binder, bolted to the pedestal. This binder strengthens the pedestal and insures correct alignment of side in which axle box slides. The weight of the locomotive is carried on high duty coil springs which ride on top of the axle box. Couplers and bumpers are made in accordance with New Zealand Railway Standards. A steel cab mounted in the centre of the locomotive, built of heavy sheet steel with two sliding doors at diagonally opposite corners is reached by means of hand rails and ladders. There is a window in each side and in the front and back of the cab. Windows and doors are rattle proof.

BATTERY AND CRADLES.—The Edison battery is divided into two compartments, each of which is securely mounted in a *removable* type of all steel cradle. This removable feature makes possible quick change of battery if it becomes necessary to utilise duplicate sets in order to increase the all day working capacity of the locomotive. The arrangement also allows ready access to the motors. Cradles are mounted on rollers so that they may be easily pulled off the chassis. The battery consists of 126 cells Edison type A–8, the rugged design and sturdy features of the Edison being valuable characteristics for traction work.

MOTOR.—The motor is designed with the one idea—*it must stay on the job.* Compared with other makes it is larger and heavier than they are because it is more liberal in design. Motors are built to suit the locomotive and are not selected from the nearest available design.

A large liberal commutator with solid high risers makes the " heart of the motor " cool running, strong mechanically and long lived. The armature which is single geared to the axle runs approximately 275 R.P.M. at full draw bar pull. The armature laminations carefully annealed and japanned before assembly, are keyed to a cast steel, not cast iron, spider, and the commutator bushing is carried on an extension of this spider. The armature coils are D.C.C. wire insulated with Empire cloth and tape, distributed over the coil in a manner to give the best mechanical and electrical protection. The slot is closed by means of a top stick placed under the band wires. Hard solder (60–40) is used for soldering band wires, and for soldering armature leads to commutator risers. Finished armature coils are dipped in insulating varnish and baked dry.

Field coils of strap copper are wound with *mica* between turns and are covered with mica and heavy canvas. Over the canvas is a wrapping of heavy web tape. Finished coils are dipped in insulating varnish and baked dry. Coils are supported on poles by brass coil hangers which serve the double purpose of holding the coil securely against motion along pole piece due to frequent reversals of current, and protect them against grounds on the pole horns. The pole pieces of laminated type are held in the frame with large bolts. The cast steel frame is split in a manner which provides easy access for inspection and repair of all parts. End plates are held in a large groove and heavy lugs are provided to hold them in position. Two brush holder sets mounted in the top half directly under the hand hole make inspection of brush rigging easy.

CONTROLLER.—In keeping with the motors, the controller is of special rugged and simple design developed for heavy locomotive work. All fingers are exactly alike. Where carrying capacity demands it, two fingers are mounted on a common base. All contacts of cast copper are reversible, permitting maximum amount of wear before renewal is necessary. The controller is of the magnetic blow-out type.

A large ribbon copper coil, turns of which are insulated with mica, carries full locomotive current and provides a strong magnetic field for blowing out arcs formed at change-overs. Asbestos wood barriers between fingers prevent short circuits and thus assist in providing a safe and satisfactory means of control. The top of the controller is brass. The operating handle is a malleable casting insulated with a wood roller. The reverse handle is of malleable iron.

CONTROL GRIDS.—The resistance grids are of three-point suspension type mounted on studs insulated with mica tubing. The surfaces between grids are faced and ground and copper washers are used to ensure good contact.

DRAW BAR PULL, SPEED.—The rated draw bar pull of this locomotive is 2,000 pounds at a speed of about 4¼ miles per hour. At lighter loads the speed may be increased up to 10–12 miles per hour and is under very flexible control by the driver. It is usual to figure between 10 lbs. and 15 lbs. per ton for train resistance of standard railway cars, but in cold weather when axle box grease becomes cold and heavy it is safest to figure on about 20 lbs. per ton. The locomotive on this basis then would haul a train of 100 tons at about 4¼ miles per hour, against 20 lbs. per ton train resistance. Assuming this same train resistance it will require approximately 8·75 K.W. hours of battery capacity to haul 100 tons 1 mile. The Edison battery of 126 Edison A–8 cells with 45·4 K.W. hours will, therefore, haul this train 5 miles on a dry level track, per charge. This of course means that you may haul 50 tons twice as far, and also that under the usual figures for train resistance, *i.e.*, from 10 lbs. to 15 lbs. per ton in place of the 20 lbs. we have assumed, a proportionately greater amount of work could be accomplished per battery charge. For instance, at 10 lbs. per ton resistance the locomotive would haul a 200 ton train load in place of the 100 ton reckoned on.

ALL-DAY HAULING CAPACITY.—The normal hauling capacity is reckoned out above and varies, as explained, with varying conditions of track and rail friction. As it usually happens with locomotive work, however, the working capacity may be extended so as to include a full 24 hour day by using the intervals between hauls, for the purpose of battery charging. This is accomplished by inserting a standard charge plug of the Anderson type into the receptacle provided, and switching on the current. In other cases where continuous and heavy hauls are required throughout a long period a duplicate battery may be used, quick changing facilities being provided for this purpose. By this means one set of batteries may be charging while the other is working, and thus the locomotive may be kept on heavy duty continuously day and night.

COMPARATIVE OPERATING COST.—The Locomotive at work replaces five horses and three drivers and reduces the haulage cost by 50 per cent. The previous haulage costs amounted to £32 per week, whereas the cost to-day is given as £14 2s. 0d. per week.

PRICES.—These locomotives may be supplied in sizes up to 10,000 lbs. draw-bar pull, prices for which may be had on application. Some prices for the smaller sizes with standard Edison Battery equipment are given below.

Draw Bar Pull.	Edison Battery Equipment.	Hauling Capacity on level.	Price.
2,000 lbs.	120 A8	100 Tons	£3,000
2,500 lbs.	120 A10	125 Tons	£3,500
3,000 lbs.	120 A12	150 Tons	£4,000

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