

VICTORIAN RAILWAYS
20000 Volt Transmission System Cables
to Elwood, Middle Brighton & Sandringham Substations.
from Jolimont Substation. ca 1925.

From the wall of Jolimont s/s across parkland in a straight line to corner of Punt Road & Batman Avenue.

Via the Hoddle Bridge to Alexandra Ave;

East along Alex^{AN}dra Ave; south along Chapel Street; east along Malcolm Street;

South along Tivoli Road; east along Toorak Road;

South along Cromwell Road, & Cromwell Crescent; south along Surrey Road;

East along Motherwell Street; south along Williams Road, continuing

South along Hotham Street into Brighton Road to Elsternwick Junction.

South along New Street; west along Head Street to Elwood sub station fence.

A parallel cable to the one above, about 6 inches apart, continued on to Middle Brighton s/s via the following route:- south along New Street;

South/east along Allee Street & Outer Crescent Brighton;

South east along Lindsay Street leading to Railway land to Middle Brighton s/s.

A third cable via ^{THIS} ~~the above~~ route connected Elwood to Middle Brighton s/s.

Transmission cable between Middle Brighton & Sandringham substations; via west side of railway reservation past Middle Brighton station to Well Street.

The cable then crossed to the east side of the railway reservation, where it continued such to Sandringham, west of Harston Street to the s/s. (The portion of this transmission cable between Sandringham back to South Road Brighton is still used as a Electrolysis Drainage Feeder)

*see EE Beh Drgn^o L 3114
no date.*

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POWER SUPPLY for VICTORIAN RAILWAYS ; ELECTRIC STREET RAILWAYS.

SANDRINGHAM SUBSTATION

The Sandringham to Black Rock E.S.R. was authorised by the Victorian Parliament on 2 Nov. 1914 when World War 1 had already broken out. The Government had decided in 1912 to electrify the Melbourne suburban railway network. Contracts had been let in 1913/14 for the supply of plant and equipment for this large scheme.

It was anticipated that the first electric trains would be running on the Sandringham line by 1915. In 1914, when the estimates for an electric tramway to Black Rock were being drawn up, the V.R. Electrical Engineering Bch (E E) understood from the Transportation Bch (Traffic) that a maximum of two trams would be in service at one time. During busier periods a trailer car would be attached to each of the two motor cars in running. On this basis it was estimated that four motor cars would be required (2 in running, 1 standby & 1 under repair or overhaul) and two trailers for holiday traffic. The E.E. Bch would be aware that the max. tram service would use less power than that by one full length electric train.

In order to contain costs, it was decided to power the trams by taking D.C. power at 1,500 volts from the railway overhead at Sandringham station and reducing this voltage to 550 by means of two boosters (motor generators--1 booster in use, 1 in reserve) They were to be housed in a small gal. iron building at Sand ringham. Estimated cost of this supply was £1,800..

The sum authorised by Act N° 2556 (1914) for expenditure on the construction of the line was not to exceed £46,500 which included £6,500 for rolling stock. In min. N° 29 of Elec. C'tee dated 29 June 1915 is a reference to a suggestion by Mr Merz to eliminate the expense of voltage reducing equipment for the Black Rock line by running the trams directly on the 1,500 volts. The suggestion was turned down because it conflicted with the desire for the line to be in harmony with the existing tram systems with the prospects of it being taken over by a central tramway authority in the future.

However, a change of plan was recorded in Elec. C'tee min, N° 35 on 11 June, 1915 - "The C.E.E. to make necessary arrangements for provision & equipment of a transformer house of brick construction". E.C. min. N° 73c of 19 Oct, 1915 records that Mr Stone is looking into the prospects of operating the Black Rock line from the Elwood sub/stn. E.C. min. N° 81 of 26 Nov. 1915, records that Mr Stone reports that owing to electrical difficulties it was now proposed to revert to the original scheme to provide a sub station at ^{AN}Sandringham.....

E.C. min. N° 69 of 18 Jan 1916 - records that it is advised that the estimate for a s/s at Sand'ham was considerably in excess of the original est. (£1,800)

E.C. min. N° 70 of 25 Jan 1916 - Tenders have been called for Sand'ham s/s electrical equipment. Mr Stone is considering whether it would be practicable to use the existing steam plant at Elwood to power the Black Rock line. (relocation or transmission of the power?????LWR)

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POWER SUPPLY for VICTORIAN RAILWAYS ; ELECTRIC STREET RAILWAYS.

SANDRINGHAM SUBSTATION.

E.C. min. N° 62 of 5 May 1916 - tenders received for Sand'ham s/s plant were much higher than had been anticipated.

E.C. min. N° 55 of 3 Nov. 1916 - noted that the estimate for generating plant is being revised on the basis of supplying power for six motor-cars & six trailers (instead of 4m & 2t).

E.C. min. of 15 Dec 1916 - Committee decided to recommend a s/s at Sand'ham equipped with rotary converters (2 x 150 Kw) and transformers operated with A.C. current from Middle Brighton s/s at 3,300 volts. (from memo from Mr E.B. Jones, Chairman, Elec. C'tee, dated 11 Oct 1917 - P.R.O. Ser. N° 10297, u/34). This scheme was considerably more expensive than the original scheme, but it provided for a greater service and for a proposed extension from Black Rock to Beaumaris.

E.C. min. N° 59 of 12 Jan 1917 - Commissioner s'Approval was given for the above scheme; tenders were called for equipment.

E.C. min. N° 51b of June 8, 1917 - In the event of no satisfactory tender being received re above, it was decided that power be provided by using portion of the Dandenong Rd to Caulfield electrification cable? and transferring on e converting set from Elwood to Sand'ham.

E.C. min. N° 29 of 25 Sep 1917 and

E.C. min. N° 34 of 19 Oct. "-- owing to the high prices quoted in the tenders for Sand'ham s/s equipment and the uncertainty of delivery, the Commissioners have approved of the 'fall back' scheme of transferring one of the Elwood converting sets to Sand'ham s/s; a quantity of electrification cable to be used for the connection between Middle Brighton & Sand'ham s/s.

Tenders for plant at Sandringham Substation.

The lowest tender was for plant of British manufacture. & subject to permission from (British) Ministry of Munitions

| | | |
|--|-------|----------------|
| | ----- | £4,738-- |
| Cables & Access. of Canadian manufacture | | 3,084-- |
| | | <hr/> £7,822-- |

| | |
|---|-----------------|
| To be added - estimated cost of laying cable, | |
| erection of buildings, foundation for rotaries etc. | 1,266-- |
| Est'd cost of freight, insurance & sundry charges | 1,170-- |
| Total estimated cost | <hr/> £10,258-- |

Having decided to reject all tenders for the Sand'ham s/s plant, and to transfer a converting set from Elwood, the arrangements entered into were as follows:- as the converting transformer in the set from Elwood was designed for a 20,000 v. input, it was necessary for a suitable transmission cable to be used. A cable of 0.1 sq. in. sect., which was originally purchased for a cross connection between Mid. Brighton & Caulfield traction substations was used. The cable run was 15,040 ft. long.

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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS.
SANDRINGHAM SUBSTATION.

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During Jan 1918, The British Insulated & Helsby Cables Ltd. laid the 20,000 volt cable from Mid Brighton to Sandringham s/s; the completion of this work was reported to the E.C. (min. N° 42c) on May 19, 1918. In the meantime the ^{WAV 4 WORKS BRANCH} Construction Branch was constructing the brick s/s. In order to limit the cost of the work provision for only one converting unit was made, the second converting set to be acquired as soon as possible, wartime industrial conditions notwithstanding. However, as the actual cost of the power supply was greatly in excess of the amount voted by Parl. in 1914, it was necessary to go to the Minister of Railways to explain the situation and to request additional funds. These extra funds were for additional rolling stock, enlarged car shed, accommodation for extra staff plus the additional cost of the power supply.

Allowing for the professional embarrassment of having to rectify an inadequate estimate, it was decided to limit expenditure for the substation and provide for only one converting set. The total construction costs of the Black Rock line compared to the original estimate was as follows:-

| | |
|---|-----------|
| Total construction costs -subject to adjustments- was | £61,662 - |
| Original estimate approved by Parl. in Nov. 1914 | £46,500 - |

(Taken from a report - R.C.B. to Minister of Railways dated Nov 28, 1917)

The E.C. minute N° 48 of June 28, 1918, reports that "..... the rotary, transformer, starting panel, field rheostat etc. have been installed....." at Sandringham.

It is interesting to note that there was no high tension circuit breaker at Sandringham s/s. The circuit breaker at the Mid Brighton end of the transmission cable was relied on to protect this circuit in the event of faults. Probably the need to limit expenditure on the substation was behind this action, apart from the difficulties of obtaining a circuit breaker owing to the war.

The transfer of N° 3 converting set from Elwood to Sandringham was carried out by the British Westinghouse Electric & Manuf. Coy. as a variation to the original contract. This work cost £56/19/6 for the transfer and £13/14/2 for alterations to the position of the field rheostats to the converters (N°s 1 & 2) remaining at Elwood. Total £70/13/8. (from a letter to B.W.E. & M. Coy dated 28 Sep. 1918)

Mr Stone advised the E.C. on Sept. 5, 1918 that the s/s was ready for commissioning. On Feb. 27, 1919, Elec. Engineer Steiger reported to Asst. C.E.E. (H.P. Colwell), re a 'pressure test' of the overhead gear of the Black Rock tramway. The test was made on Feb. 26, 1919 and consisted of 1400 volts, 25 cycles for 15 minutes between 10.31am & 10.46. A 'megger' test before and after the 1,400 volt test gave 75,000 ohms. The weather was cool with a few drops of rain and windy. As a result the line was considered O.K., but the tramway could not be brought into use however as the rolling stock had not yet been delivered. The stock earmarked for Black Rock use had first to be released from the St Kilda line. This could not happen until sufficient D/T cars had been put into service at Elwood. The released trams had then to be transferred to Newport Workshops to have the cars converted from broad to standard gauge.

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The story of the location of the Sandringham substation and the car shed has some interesting components.

It was conventional wisdom to have a car shed at the outer terminal of a line in order to cut down unprofitable dead or empty car running. Mr Kernot, C.E.R.C. intended to have the car shed at Black Rock. In Jan. 1914, prior to the Construction Act being passed by Parliament, advice was sought from the V.R. Estate Officer as to the then current value of land of suitable dimensions near the terminus at Bluff Rd & Balcombe Rd. Whereas the land selected as the best one (north/east corner, Bluff & Balcombe Rds.) was valued at £3 per foot early in 1914, it transpired that shortly after the authorising Act was passed on 2 Nov. 1914, the Estate Officer reported that £20 per foot was being asked.

In the money authorised by the Parliamentary Act No. , £400 was provided for the purchase of land for a car shed site. Consequently, steps were taken to look at alternative sites along Bluff Rd. These were seen to be either too expensive or lacking sufficient depth. For some reason objection was taken to acquiring land covered by more than one title. A stalemate had been reached in the matter when R.C.B. engineer Mr A.W.L. Paul suggested to his Chief on 1 May 1915, that Crown land in the Beach Reserve (between the Beach Rd & the coastline) could be taken as a site for the car shed. A siding track, as an extension from the tram ~~XXXXXX~~ terminus would cross the Beaumaris Horse Tramway in Beach Rd. on the level and lead into the car shed. Enquiries ~~XXXX~~ made through the V.R. Estate Officer revealed that the Lands Department advised that before any action could be taken the consent of the Moorabbin Shire Council to the proposal would be necessary.

In response to a letter from R.C.B. on the proposal (18 June, 1915) The Shire of Moorabbin replied (6 Aug. 1915) to the effect "that the Council objects to any portion of the Beach Park being used for the purpose mentioned."

The Railways, after the Council's rejection of their proposal, looked further into the legal position of the Crown lands comprising the Beach Park at Black Rock.

The V.R. Estate Officer ascertained that the council was only a "Committee of Management" and had no control of the fee-simple; ^(THE COUNCIL'S) "A....the objection should not debar this Department from obtaining possession of the land...." The proposed car shed at Black Rock was intended to be a temporary structure bearing in mind the expected extension of the tramway to Beaumaris. In that case the shed was to be transferred to that terminal. On the 1 May 1916, it was decided to test whether the Council's "refusal of assent" barred all further action. It was understood that the land belonged still to the Government and "...is not vested in the Council and can be utilized if thought necessary for railway purposes..."

A letter dated 18 May 1916 from the Estate Officer to the C.E.R.C. suggested that the land be taken under the authority of the Railway Construction Act.

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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS.

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SANDRINGHAM SUBSTATION.

However, the R.C.B. had a change of plan which required land for a car shed near Sandringham station. This new situation was due to Mr Stone (C.E.E.) advising the Asst. C.E.R.C. on 5 Nov. 1916, that for reasons of economy it was desirable to have the car shed and the substation on the same site. By having the car shed staff qualified to attend the substation £300 p.a. could be saved.

In a memo. dated 1 Mar 1917, the C.E.R.C. advised his staff of this change and "pointed out that at times when rushes of traffic occur it will be much more convenient to have spare cars & trailers available in a car shed close to Sandringham station rather than out along the route of the S.R..." Land near Sand'ham stn. was more expensive than that at Black Rock, but the saving in 'working expenses' of £300^{p.a.} justified capital expenditure of £6,000 or more and despite extra cost of wages of tram crews during empty car running.

After a survey of possible sites, 6 were listed in order of suitability. Then the V.R. Commissioners offered land in the Sandringham station grounds at no charge. I think the Commissioners probably saw a saving in the form of reduced interest on capital expenditure in the working expenses as an advantage to them in the management of a line which had only marginal economic prospects.

Site N° 1 - In Bamfield Street (South) ~~facing south~~, between Moor St & the railway, (94 ft X 249 ft).. It had an advantage of having a street on one side and the railway on the other -- making it easily accessible for the underground transmission cable from Mid. Brighton s/s. Also Station St faced the site and it could be used for the entrance tracks. A rather long siding of 190 yards would be necessary to connect with the end of the street railway. Estimated cost of land + 10% = £1,870.

Site N° 2:- N/W corner of Abbott & Station Sts. (116' x 248'); suitable for working purposes being close to the terminus, but cost of purchase was high. Estimated cost of land + 10% = £3,360. Today the site is occupied by the Citizens Advice, Child Health and houses in Station St. 'Abbott St.

Site N° 3:- On the north side of Abbott St. opposite Waltham St. (114' x 200') of medium cost, est 'd + 10% = £2,150. Depth was rather short and could not be extended owing to a right-of-way at rear. A siding, probably along Abbott St. and south into Station St. would be necessary to link with the S.R.. Today the site is occupied by residences N°s 15 & 17 Abbott St.

Site N° 4:- On the north side of Sandringham St.(Rd) between Harston & Trentham St. (130' x 240'). Entrance tracks could be either east or west end. In either case a siding, c@ 200 yards long would be necessary to connect to the S.R., either along Trentham St. or through V.R. station grounds. The latter would be cheaper owing to it not being laid in a public road. The est'd cost of land was moderate- £1,410. Today the site is occupied by housing.

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SANDRINGHAM SUBSTATION.

Site N° 5:- On the south side of Bay Rd.- west of the Anglican Church- this is an irregular piece of land- 50 ft. frontage extends south to Sims St. for 254 ft. Alongside is another block of 70 ft. frontage but only 127 ft. in depth. This land is adjacent to the S.R. in Bay ~~XX~~ Rd. The cost of purchase was considered to be moderate (£1,070) but construction costs would be more expensive- the land falls away rapidly from Bay Rd. towards Sims St. Today, ^{THE} site is occupied by shops.

Site N° 6:- On the north side of Bay Rd. adjacent to the east boundary of the station grounds. (92 x 224 ft.) The land was high at the back and would need to be cut down- otherwise is suitable- Est'd cost of land + 10% is moderate-£1,580. Today, site is occupied by shops (and a late timber yard.)

Site N° 7:- This site is within the station grounds on the east side and was offered by the V.R. Commissioners at no cost to the Board of Land & Works. Its main drawback was the narrowness- 47 x 360 Ft. depth. The design of the shed ~~would need to~~ ^{NEEDED} be modified by placing the workshop & store at the back instead of at the side. Offices would have to be in a separate building to be erected elsewhere. This location was satisfactory with regard to the u/g transmission cable from Mid. Brighton s/s to the Sand'ham s/s.

It was considered that sites N°s 4,5,6 & 7 would be expensive to work owing to difficulties in shunting R/stock. ??

The decision was made to accept the offer of the Comm'rs and site N° 7 was approved. The substation was placed at the rear of the car shed near Sandringham Rd. Upon the closure of the E.S.R. in 1956, the s/s was stripped of its electrical gear and the building was converted into a crew & locker room for the motor garage staff and the crews of the motor buses which replaced the trams. It exists to this day (1995)

The information about possible shed sites was obtained from corres.(R.C. 17/1624, dated 19-3-1917;) from engineer A.W.L.Paul to the Asst. Chief E.R.C. (P.R.O. Ser. 10297, unit 34)

The Way & Works Branch of V.R. built the Sandringham s/s as part of the Electrification ~~XXXXXX~~ of Suburban Railways scheme. The building was of brick & concrete construction, with a flat roof including a Boyles type ventilator.

According to the ^{PROGRESS} ~~Final~~ Return for construction of the line the following dates record progress.

| | |
|--|-------------|
| Excavations for foundations in progress | Mar. 1918 |
| Brickwork complete & reinforced conc. slabs for roof erected | May 1918 |
| House ready for installation of machinery | 18 May 1918 |
| Transformer & rotary in position | 15 June " |
| " & " fitted up. | 20 Jul. " |

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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS.
THE SANDRINGHAM SUBSTATION.

H2

installation of machinery at s/s cont'd.

Positive and negative returns connected up;

24 August, 1918.

Brief dimensions of s/s building at Sandringham.

The original building was for a single unit converting set.

The length of building lies E-W.

| | |
|--------------------------------------|----------------|
| Length - outside | 35 ft. 1 in. |
| " - inside - machine room | 21 ft. 7½ in. |
| " - inside - transformer room (cell) | 10 ft. 10½ in. |

Width - N-S

| | |
|-------------|---------------|
| " - outside | 16 ft. 8 in. |
| " - inside | 14 ft. 10 in. |

| | |
|-------------------------------------|--------------|
| Height - floor to underside of roof | 15 ft. 0 in. |
|-------------------------------------|--------------|

During 1921/22, this building was extended to accommodate a second converting set.

The extension was on the south side, which increased the width to:-

| | |
|---------|---------------|
| outside | 24 ft. 10 in. |
| inside | 23 ft. 0 in. |

The other dimensions remained the same.

The second converting set installed was also of 350 Kw as before, but was of Metropolitan Vickers trade mark, but was otherwise identical to the British Westinghouse machine installed in 1918. It was highly desirable for any duplicate electrical plant to be of the same specification as the original in order to facilitate the paralleling of machines in operation.

With the extension of the Black Rock line to Beaumaris in 1926, an additional feeder was provided from the substation to Black Rock to power the extension. Presumably the double line of trolley wire was considered to be ample feeder capacity between Sandringham and Black Rock.

A new control panel for the Beaumaris feeder was installed in the substation.

The feeder was of .5 sq. in. section and was carried on the poles which supported the overhead gear. It is understood that the first switchboard panels at Sandringham were secondhand from the old Elwood steam power house.

With the cessation of the tram service between Black Rock and Beaumaris on 1 September, 1931, it was decided to leave the Beaumaris feeder in place along the route to Black Rock.

The above circumstances, brought about mainly by the effects of World War 1, resulted in the Black Rock tramway surely being ^{ONE OF} the most overpowered tramways in existence. Here was a line after 1931 which normally ran a full service with three, later four, double truck four motor cars ^{WITH} having a maximum installed generating capacity of 700 Kw (2 rotaries). In addition a 0.5 sq. in. feeder paralleled the double trolley wires over the 2.42 miles of route to Black Rock.

POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS.

(b)

SANDRINGHAM SUBSTATION.

The building consisted of two portions - viz. The original part and the 1922 extension, each of which contained a step down transformer and a rotary converter.

This equipment was identical to that in use at Elwood substation. The building was much simpler in design than Elwood, being a brick and concrete structure of only of a single floor. Large wooden doors were provided in the walls at the required places to permit the passage of the rotaries or the transformers. Alongside the western end wall was a steel gantry for lifting of the transformers off road transport. The yard at the rear of the Sandringham Car Shed was enclosed by a substantial gal. iron fence, which also enclosed the substation, was provided with sets of heavy gates. These gates gave access to the yard from the roadway in the public railway siding alongside. Other sets of gates were opposite the equipment doors in the substation.

Power was transmitted from the V.R. Middle Brighton s/s at 20,000 v., 3 phase, 25 cycle, A.C. by means of an underground cable. Generally this cable was laid at the side of the railway reservation between Mid. Brighton and Sand'ham. The cable ~~was~~ was not duplicated and any failure of it meant the shutting down of the tramway until repairs were effected. On reaching the west end of the s/s the cable branched into the feeds for the two converting units. Different to Elwood s/s, the u'ground feeder from M' B'ton only had a protective oil circuit breaker at the Mid. Brighton end. At Sand'ham bus bar isolating switch intervened between the cables and the two main transformers. The transformers were at the west end with a passage separating; they were mounted on undercarriages which ran on rails set into the floor to the western doors. Access to the passage from the machine room was through an interlocked steel door. The rotary converters were side by side in the machine room in line with their transf'rs. Hoisting gear was attached to girders fixed above the rotaries. The switchboard was located across the eastern wall of the machine room.

At the outset, from 1919, the switchboard consisted of three panels until a fourth panel was added in respect of the second converting set in 1922. However with the extension of the route from Black Rock to Beaumaris, which was opened for traffic on Sep. 1, 1926, a fifth panel was added in connection with an additional feeder to Black Rock for the line to Beaumaris. After that date the panels were described as under:- Panel N° 1: "Feeder" panel; mounting a 600 amp, 650 v. circuit breaker.

Ammeter - 50/0/1000 amp. - 1.

Voltmeter - 400/0/700 volts. on a swinging bracket.

'Car Shed' cir,breaker, 300 amp. 650 v. (G.E.Coy, type C, form P.)

Recording ammeter. (Elliot Bros.)

Panel N°2: "Instrument" panel; mounting a 1000 amp, 600 v. knife switch, s.p.

Ammeter: 0 - 50 amps.

Voltmeter as above for panel N° 1.

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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS.
SANDRINGHAM SUBSTATION.

Switchboard Panel N° 3, :- "Rotary" converter, mounting a 1000 amp, 650 v. circuit breaker. Knife switch- s.p., 1000 amp, 600 v.

Type 'Y' Intergrating watt hour meter.

Panel N° 4:- "Rotary" converter- mounting a 1000 amp, 650 v. circuit breaker.

Knife switch, s.p. - 1000 amp, 600 v.

Type 'Y' Intergrating watt hour meter.

Panel N° 5, :- "Feeder-Beaumaris" - mounting a 600 amp, 650 v. circuit breaker.

Knife switch - s.p. -600 amp., 600 v.

Ammeter - 50/0/1000 amps.

Recording ammeter, (Elliot Bros), 300-0-1200

ELWOOD

ELWOOD & SANDRINGHAM SUBSTATION PLANT

SANDRINGHAM

MAIN CONVERTER TRANSFORMERS

| | No 1 | No 2 | No 3 | No 1 | No 2 |
|---|----------|---------|------------------------|--------|--------------|
| Maker | BME&M | BME&M | BME&M (sic) (MVE ?) | BME&M | MVE |
| Ser. No | B 264322 | B264323 | 351790 | 264321 | B 351791 |
| ROTARY CONVERTERS | | | | | |
| Maker | BME&M | BME&M | MVE. CO. | BME&M | MVE CO. |
| Maker's Frame & Armature Ser. No | 629828 | 629827 | 244 V.S. | 629826 | 246 V.S. |
| Pony Motor No | 304443 | 304442 | C 242 C 59/1 | 304441 | C 242 C 59/2 |

(SIEMENS?) 'PIRANI' BOOSTER (ELWOOD ONLY)

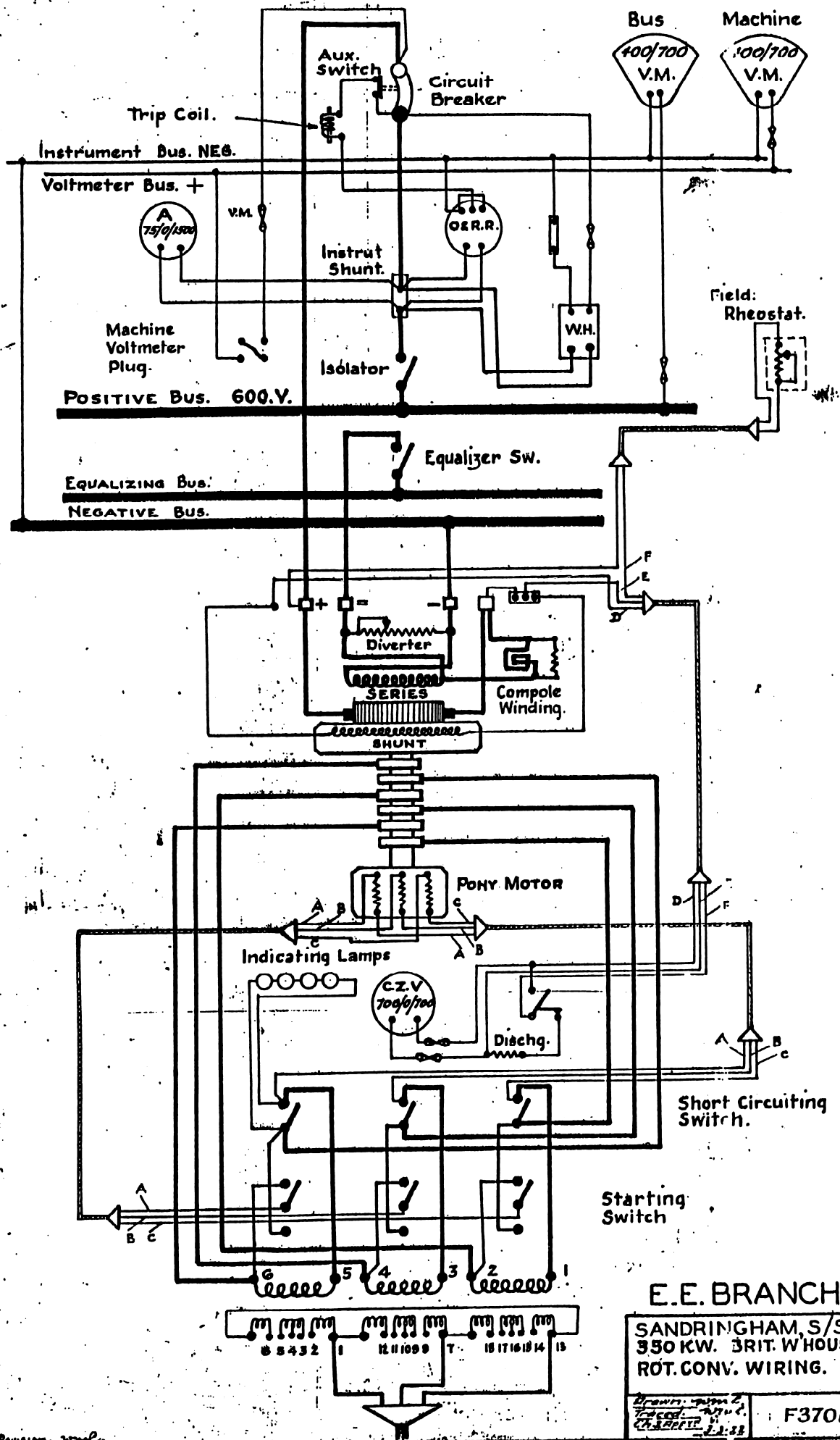
| | | | |
|---------|----------|-----------|---------|
| Maker | Motor | Generator | Exciter |
| Type | G.M. 234 | G.M. 234 | G.M. 84 |
| Ser. No | 474550 | 474549 | 474551 |

BME&M = British Westinghouse Electric & Manufacturing Co.
MVE = Metropolitan Vickers Electric Co. Ltd.

Elwood :- Information from data sheets Nos 45, 46, 47, 48
Sandringham :-
No 72 - 1107.23
47 A
47 B

(145)

47 A
47 B



E.E. BRANCH
 SANDRINGHAM, S/S
 350 KW. BRIT. W.HOUS.
 ROT. CONV. WIRING.
 Drawn: [Signature]
 Checked: [Signature]
 Date: 1.1.58
F370A

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TECHNICAL PARTICULARS

TRANSFORMER

Volts 20000/408

Phases 3

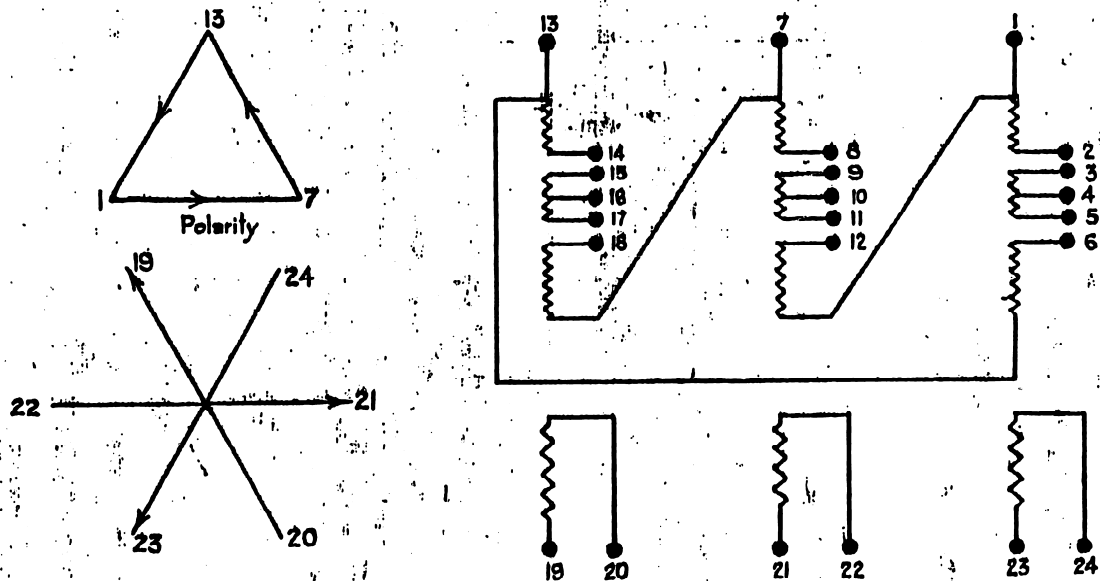
Rating 385 K.V.A. max. cont.

C rise (by resistance)
oil 33°-35° C " (by thermometer)

48°-70° C total " "
118°-158° F " "

Cycles 25 Impedance 15.25% approx.

Type Core



| Volts | Between | Link | Volts | Between |
|--------|------------|-------------------------------------|-------|---------------------|
| 20,000 | 1 - 7 - 13 | 2-3; 5-6; 8-9; 11-12; 14-15; 17-18 | 408 | 19-20; 21-22; 23-24 |
| 19,500 | " | 2-4; 5-6; 8-10; 11-12; 14-16; 17-18 | " | " |
| 19,000 | " | 2-6; 8-12; 14-18; | " | " |
| 18,500 | " | 2-5; 4-6; 8-11; 10-12; 14-17; 16-18 | " | " |
| 18,000 | " | 2-5; 3-6; 8-11; 9-12; 14-17; 15-18 | " | " |

| | |
|--------------|-----------|
| Oil (Volume) | 450 Galls |
| Oil | 1.8 Tons |
| Windings | } 5.1 " |
| Tank | |
| TOTAL | 6.9 " |

| OVERALL DIMENSIONS | |
|----------------------------------|----------|
| Height | 10' - 0" |
| Length (parallel with Terminals) | 7' - 7" |
| Breadth | 4' - 6" |

Contract B.W. - Elwood & Spencer 5th Section A

Maker B.W.E & M. C. L^{td} Manchester Eng.

Elea. Spec. No 36702

Serial No B264381-2-3

| FUNCTION | LOCATION |
|------------------|--------------------|
| Rotary Converter | Elwood Sandringham |
| " | " |

DRAWING No 1836
DRAWER No 21
26/6/19

File No F 229

(a)
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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS
CONVERTER TRANSFORMERS

The main transformers at both Elwood (3) and Sandringham (2) substations were of British Westinghouse or Metropolitan Vickers manufacture. They were of the three-phase oil insulated type cooled by natural radiation from the case. The steel oil case contained 450 gallons of refined mineral oil "from the Russian oil fields" according to the specifications. The transformer was of the CORE type; 20,000/408 volts; 385 K.V.A. max. cont. rating; 25 cycles; 15.25% impedance.

| | | |
|----------------------|---------------------------------|---------------|
| Overall dimensions:- | height | 10 feet 0 in. |
| | length, parallel with terminals | 7 " 7 in. |
| | breadth | 4 " 6 in. |
| | total weight | 6.9 tons. |

ROTARY CONVERTERS

The three rotary converters at Elwood (2 British Westinghouse & 1 Metropolitan Vickers) and two at Sandringham (1 British Westinghouse & 1 Metropolitan Vickers) were self excited, compound wound, self synchronising and were started from the alternating current side. The normal operating conditions were:-

| | |
|------------------------------|--------------------|
| D.C. terminal pressure | 600 volts |
| H.T. " " at no load | 19,000 volts |
| " " " at 3 times normal load | 18,500 " |
| Periodicity | 25 cycles per sec. |

A starting motor was mounted on an extension of the armature shaft. The necessary A.C. power for starting each converter was derived from its own transformer.

| | |
|---|------------|
| Speed at a frequency of 25 cycles per sec. | 500 r.p.m. |
| N° of slip rings | 6 |
| N° of slots | 108 |
| N° of commutator bars | 432 |
| N° of bearings | 2 |
| Peripheral speed of commutator, feet per min. | 3230 |

Output:- 350 Kw, continuously (ie 525 amps at 600 volts)
525 Kw, for two hours (ie 375 amps at " ")
700 Kw, for 10 minutes (i.e. 1170 amps at 500 volts)
1,050 Kw, momentarily (" 1750 " " " ")

Weight of machine -

As a matter of record the contract price of one 350 Kw rotary converter set with transformer, rheostat and starting gear complete -- £2,453 each; Oct. 1917.

(a)
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POWER SUPPLY for VICTORIAN RAILWAYS ELECTRIC STREET RAILWAYS
CONVERTER TRANSFORMERS

The main transformers at both Elwood (3) and Sandringham (2) substations were of British Westinghouse or Metropolitan Vickers manufacture. They were of the three-phase oil insulated type cooled by natural radiation from the case. The steel oil case contained 450 gallons of refined mineral oil "from the Russian oil fields" according to the specifications. The transformer was of the CORE type; 20,000/408 volts; 385 K.V.A. max. cont. rating; 25 cycles; 15.25% impedance.

| | |
|---------------------------------|---------------|
| Overall dimensions:- height | 10 feet 0 in. |
| length, parallel with terminals | 7 " 7 in. |
| breadth | 4 " 6 in. |
| total weight | 6.9 tons. |

ROTARY CONVERTERS

The three rotary converters at Elwood (2 British Westinghouse & 1 Metropolitan Vickers) and two at Sandringham (1 British Westinghouse & 1 Metropolitan Vickers) were self excited, compound wound, self synchronising and were started from the alternating current side. The normal operating conditions were:-

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700 Kw, for 10 minutes (i.e. 1170 amps at 500 volts)
1,050 Kw, momentarily (" 1750 " " " ")

Weight of machine -

As a matter of record the contract price of one 350 Kw rotary converter set with transformer, rheostat and starting gear complete -- £2,453 each; Oct. 1917.

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POWER SUPPLY for VICTORIAN RAILWAYS, ELECTRIC STREET RAILWAYS
SECTIONALIZING of OVERHEAD TROLLEY WIRING
St KILDA - BRIGHTON LINE

The original power supply for the above line of tramway was of 550 v. d.c. supplied by steam generating sets at the Elwood Power House. Two "feeder circuit breakers" were provided on the power house switchboard. The route from St Kilda station to Brighton Beach was divided into two sections, viz. St Kilda Stn. to the power house and from the power house to Brighton Beach. (Aust. Mining Standard, May 1906, The single line route with passing loops (turnouts) was equipped with twin trolley wires (000 3&S gauge) except at passing loops. The overhead material was supplied by Aust. Gen. Elec. Coy.. The overhead line was mainly hung from span wires on opposite wooden poles in suburban streets, except along Broadway, Elwood, where centre poles and side arms were used.

Originally span poles were painted dark green so as to be ^{AS}unobtrusive as possible. The City of St Kilda was successful in 1916 in persuading V.R. to paint white the span poles in that municipality. A sidelight to the supply of span poles during construction of the E.S.R. in 1905-6 related to the number of poles rejected by the Gov't timber inspector as not being to specification. A timber cutter, in a letter dated 16/2/'06 to the Engineer-in-Chief advising delivery of his poles at Rushworth R/Stn., noted at the conclusion that if "Mr (Timber Inspector) Smith comes to pass the poles we will have to grow the timber to order." The poles were required to have sapwood cut away and the pole to be dressed hexagonal at the base & round for the remainder.

"...A copper feeder cable of 300,000 mils runs from the Power House to St Kilda R/S as owing to the gradients at this end of the line extra capacity was necessary"... (AMS, 5/'06) When the Elwood Sub Station was commissioned in Dec. 1918 the line voltage was increased to 600 volts. E.E.3ch Drg. N° 1788, dated 17/12/1918 showed that a feeder in St Kilda St went to Brighton. It is not known whether this feeder was installed in conjunction with the new substation or if it was provided at an earlier date. For the first few weeks the steam generating plant was kept on stand-by during the shakedown period when a few teething troubles occurred in the S/S. An underground transmission cable was intended to connect the S/S with St Kilda St, but this cable was not available owing to the war, a temporary double pole line was erected - the two sections of route overhead having its own feeder. (Drg. 1788 above)

After the new S/S settled down steps were taken to divide the length of route into four sections, each being fed by its own C.B. & feeder. With the end of the effects from the war on industry it was decided that a pole line had advantages over ~~an~~ underground cables as it obviated electrolysis problems. Consequently the pole line was upgraded to permanent status.

(50)

POWER SUPPLY for VICTORIAN RAILWAYS, ELECTRIC STREET RAILWAYS.

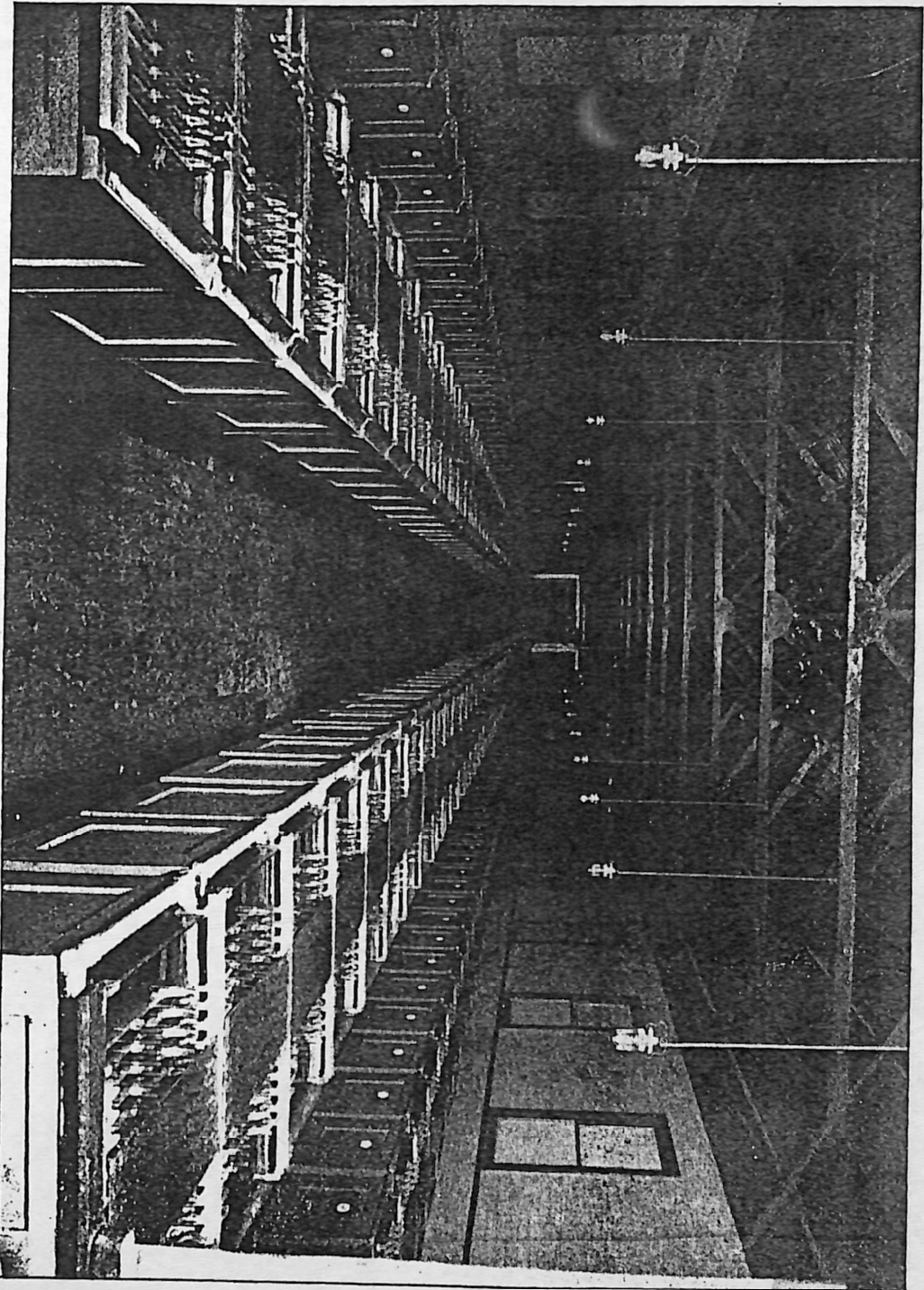
SANDRINGHAM-BLACK ROCK - BEAUMARIS, OVERHEAD SECTIONALIZING

The 20,000 volt A.C. power from the V.R. Middle Brighton S/S was transmitted to Sandringham S/S by an underground cable (.1 sq. inch X section) . After conversion to 600 volts D.C. by rotary convertor at the Sandringham S/S , a circuit breaker on the switch board supplied a feeder of .125 sq. inch cable (actually a length of trolley wire) to power the car shed tracks.

A second C/B powered the two trolley wires along the route to Black Rock, these being considered adequate as feeders in 1919.

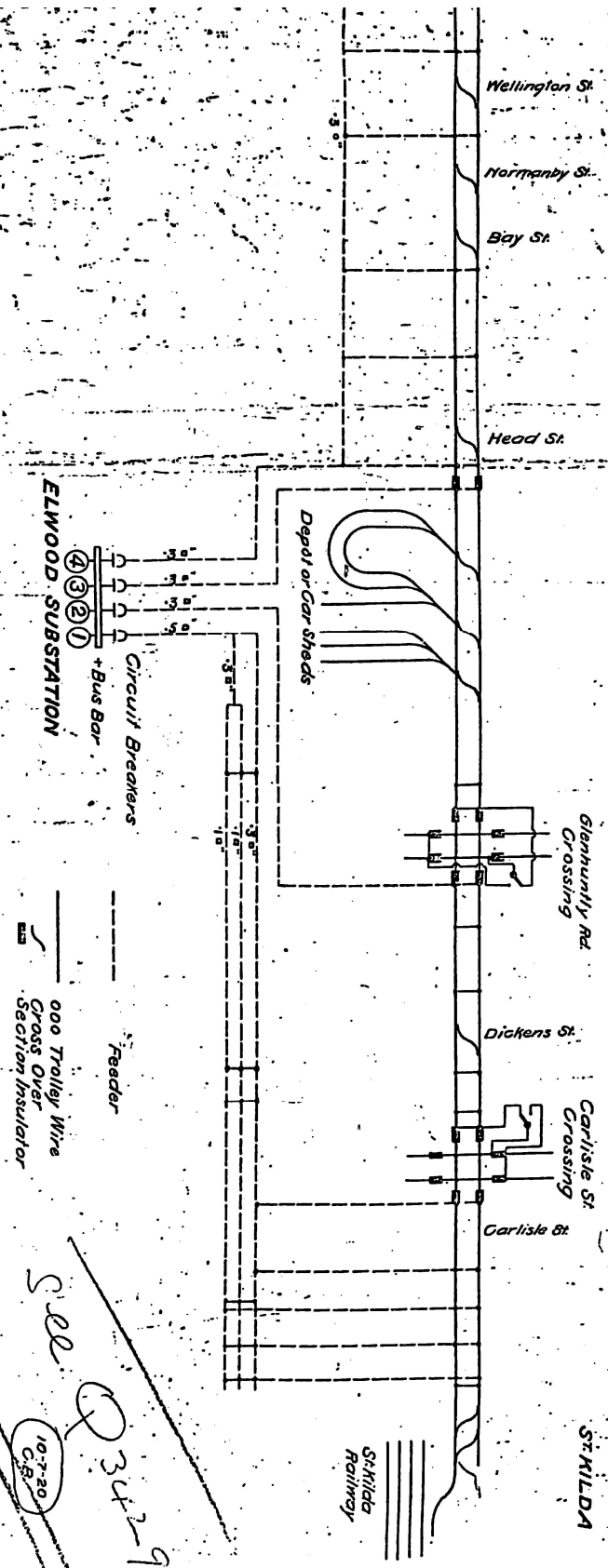
With the extension of the tramway to Beaumaris in Sep 1926, it was necessary to add another panel with a feeder circuit to power a separate .5 sq. in. feeder. The feeder was carried on the overhead poles to Black Rock, at Karakatta St, to provide adequate voltage to Beaumaris. On the closure of the Beaumaris extension on Sep 1, 1931 the feeder was left in place and jumpered across to the trolley wires at five different points along the route to improve the supply to Black Rock.

This situation remained until the closure of this tramway in Nov. 1956.



*This pic. gives an impression of what
Battery Room, at Kalgoolie, ca 1909?*

V.H. ELECTRICAL ENGINEERING BRANCH.
ST. KILDA-BRIGHTON SECTIONING DIAGRAM



See Q342-9
 10-7-20 C.B.
 Drg. No. 3119
 2550-20