SOMERSAULT

SEPTEMBER 2016
VOL 39, NO 5

SIGNALLING RECORD SOCIETY OF VICTORIA

SOCIETY CONTACT INFORMATION

Published by the Signalling Record Society Victoria Inc (A0024029F)

EDITOR: Andrew Waugh, 28 Amelia St McKinnon, VIC, 3204
Phone (03) 9578 2867 (AH), (03) 9348 5724 (BH), email andrew.waugh@gmail.com
PRESIDENT: David Langley, P.O. Box 8, Avenel, VIC, 3664, Phone (03) 5796 2337
SECRETARY and MEMBERSHIP OFFICER: Glenn Cumming,
Unit 1/4-6 Keogh St, Burwood, VIC 3125. Phone (03) 9808 0649 (AH)
NSW CONTACT: Bob Taaffe, 63 Hillcrest Rd, Tolmans Hill, TAS, 7007, Phone: (03) 6223 1626
QUEENSLAND CONTACT: Phil Barker
PO Box 326, Samford, QLD, 4520, Phone: (07) 3289 7177, email: signal-1@bigpond.com

MINUTES OF MEETING HELD FRIDAY 19 JULY 2016, AT THE SURREY HILLS NEIGHBOURHOOD CENTRE, 1 BEDFORD AVENUE, SURREY HILLS, VICTORIA

Present: – Noel Bamford, Wilfrid Brook, Graeme Cleak, Glenn Cumming, Graeme Dunn, Vance Findlay, Michael Formaini, Ray Gomerski, Chris Gordon, Judy Gordon, Andrew Gostling, Chris Guy, Bill Johnston, David Jones, Keith Lambert, David Langley, Neil Lewis, Andrew McLean, Phillip Miller, Alex Ratcliffe, Laurie Savage, Rod Smith, David Stosser, Andrew Waugh and Andrew Wheatland.

Apologies: – Steven Dunne, Chris King, Steve Malpass, Bruce McLean, Michael Menzies, Colin Rutledge, Brian Sherry and Peter Silva.

Visitor: – Nick Lapthorne.

The President, Mr. David Langley, took the chair & opened the meeting at 20:09 hours.

Minutes of the May 2016 Meeting: – Accepted as published. Graeme Dunn / Andrew McLean. Carried.

Business Arising: – Nil.

Correspondence: – The invoice for the public liability insurance was received and payment has been sent.

Letter received from V/Line requesting SRSV to vacate the leased rooms at Seymour.

Andrew Wheatland / Alex Ratcliffe. Carried.

Reports: – Archives. The letter from V/Line was discussed at length. Discussion centred on various options and suggestions about the future of the archives room and the collection. The SRSV Committee will continue to explore alternative accommodation for the archives. Any SRSV Member who can assist with sourcing a new home for the archives should contact the Secretary.

Tours. Arrangements for the Signal Box tour in September 2016 were discussed.

General Business: – Keith Lambert provided details about various works in the Metropolitan District. A summary of the discussion follows: –

- The Down and Centre Lines between Caulfield – Moorabbin will be returned to service on 1 August 2016. The Up Line between Caulfield – Moorabbin will be returned to service on 5 September 2016.
- The control panel at Moorabbin will be in use over the weekend of the changeover.
- TPWS equipment will be installed at the NEW signals between Caulfield – Moorabbin.

(Front cover) Workers install signal heads on a cantilever signal mast on the new grade separated lines between Ormond and Bentleigh. The signals on this mast became Up Automatics F452 and FM452 when the grade separation was opened on 1 August. This style of mast has become common in recent years – I believe it was first used on the Broadmeadows – Craigieburn electrification in 2007. Compared with earlier masts it appears massively over-engineered. Functionally this mast supports two three aspect LED signal heads in a small sheet steel enclosure and two marker lights; a much lighter load than the old fashioned cast iron three aspect Style R or searchlight heads. One reason for this apparent overdesign is modern OH&S requirements for safe access at heights – note the heavy cages for access to the signals, strong railings on the gantry and the substantial ladder way. All of this metal is a far greater proportion of the load than the actual signals. A further modern issue is that providing access at all requires security features to prevent unauthorised access – the access ladder way is fitted with a cover at ground level and a locked gate at the intermediate level. That this is necessary was shown at the beginning of August all lines through South Yarra were closed for several hours during the Friday evening when someone climbed onto an overhead structure. In the UK these trends have led to the development of 'modular' signal masts. These are extremely lightweight and simple masts with no provision for access. Modern LED lamps are not expected to require regular access, and when access is required, the head is lowered or mobile cherry pickers are used. Photo Andrew Waugh

- The speed limit for freight trains between Caulfield – Moorabbin will be 40 km/h.
- The Up and Down platforms at Murrumbeena will be closed for four (4) weeks in September 2016.

Chris Gordon reported that the installation of axle counter equipment at level crossings on the Pakenham Line has been completed.

Chris Gordon advised that the installation of axle counter equipment at level crossings on the Craigieburn and Werribee Lines is continuing.

Syllabus Item: – The President introduced Member Keith Lambert to present the Syllabus Item.

Keith presented a selection of 20 digital images from Victoria in the form of a "Where is it" type quiz.

The images came from a variety of sources and featured a variety of locations, both country and metropolitan, and from different eras.

The meeting was given ample opportunity to view the images and deduce, estimate or just plain guess the location of each image, with many images receiving appreciative comments.

Andrew Waugh and David Langley top scored with a few other members also scoring very well.

The presentation was thoroughly enjoyed by those present at the meeting, probably more for the great collection of images rather than being able to identify all the locations.

At the completion of the Syllabus Item, The President thanked Keith for the entertainment & this was followed by acclamation from those present, along with the promise of another invitation to do it all again at a future meeting.

Meeting closed at 22:23 hours.

The next meeting will be on Friday 16 September, 2016 at the Surrey Hills Neighbourhood Centre, Bedford Avenue, Surrey Hill, commencing at 20:00 hours (8.00pm).

SIGNALLING ALTERATIONS

The following alterations were published in WN 25/16 to WN 33/16, and ETRB A circulars. The alterations have been edited to conserve space. Dates in parenthesis are the dates of publication, which may not be the date of the alterations.

14.06.2016 **Eaglehawk** **(SW 59/16, WN 25)**

On Tuesday, 14.6., the Church St pedestrian crossing (169.524 km) was abolished. The pedestrian mazes and the footpath across the running line were removed. Amend Diagram 12/13 (Eaglehawk – Raywood).

19.06.2016 **Mooroolbark** **(SW 156/16, WN 25)**

On Sunday, 19.6., Up Automatic MLK305 was renewed with a LED mast.

20.06.2016 **Maryborough** **(SW 61/16, WN 25)**

On Monday, 20.6., the Taylor St pedestrian crossing (224.820 km) was closed until further notice. The footpath across the running line was removed. Signs will direct pedestrians to the Christian St pedestrian crossing.

(21.06.2016) **Defined station limits** **(SW 57/16, WN 25)**

SW 228/08 is reissued. When a Signallers Caution order (Form 2377) has been issued for a defective Home signal that leads to a section worked under the rules for Train Staff and Ticket, Double Line Block, Train Orders, or Track Block, the requirement that train proceed cautiously to the next fixed signal will only apply within station limits. Once outside station limits the train is to be operated in accordance with the applicable system rules.

Station Limits are defined in Book of Rules, Section 2, Rule 23C (amended by SW 11/00). For sections worked by the Train Staff and Ticket, Train Order, or Automatic and Track Control Systems, Station Limits is the portion of line extending between opposing Home signals. For sections worked by the Double Line Block, Track Block, and Automatic Block Systems, Station Limits is between the first Home signal and the Starting or Home signal leading to the next block section.

(21.06.2016) **Deer Park West – Wendouree** **(SW 58/16, WN 25)**

Operating Procedure 67 (Deer Park West – Wendouree Defective Signals) was reissued. The alterations deal with the train speeds after passing Ballarat Home 105 towards the Train Staff section, and Ballarat Home 46 towards Train Order Territory. See also SW 57/16. SW 51/16 is cancelled.

23.06.2016 **Axle counter overlays in Metropolitan areas**

On various dates, as shown below, axle counter overlays were provided at level crossings in the metropolitan areas.

Station	Road	Date	Diagram	Reference
Dandenong	Progress St	23.06.2016	27/15	SW 161/16, WN 25
Dandenong	South Gippsland Hwy	23.06.2016	27/15	SW 161/16, WN 25
Hallam	Hallam Rd	24.06.2016	27/15	SW 162/16, WN 25
Narre Warren	Webb St	24.06.2016	27/15	SW 162/16, WN 25
Yarraville	Anderson St	01.07.2016	18/14	SW 178/16, WN 27
Spotswood	Hudsons Rd	01.07.2016	18/14	SW 178/16, WN 27
Berwick	Clyde Rd	01.07.2016	3/16	SW 179/16, WN 27
Beaconsfield	Station St	06.07.2016	3/16	SW 183/16, WN 27
Beaconsfield – Officer	Brunt Rd	07.07.2016	3/16	SW 184/16, WN 27
Officer	Officer South Rd/Station St	08.07.2016	3/16	SW 185/16, WN 27
Sandown Park – Noble Park	Corrigan Rd	12.07.2016	105/13	SW 186/16, WN 27
Noble Park	Heatherton Rd	13.07.2016	105/13	SW 187/16, WN 27
Noble Park - Yarraman	Chandler Road	14/07/2016	105/15	SW 188/14, WN 28)
Clayton	Clayton Rd	15.07.2016	35/14	SW 189/16, WN 28
Aircraft	Aviation Rd & Balmoral St pedestrian crossing	18.07.2016	5/14	SW 203/16, WN 29
Altona Junction – Laverton	Maidstone St	18.07.2016	133/12	SW 204/16, WN 29
Hoppers Crossing	Old Geelong Rd	19.07.2016	5/14	SW 205/16, WN 29
Newport South	Champion Rd & Maddox Rd (See Note 1)	27.07.2016	31/12	SW 207/16, WN 30
Werribee	Cherry St & Werribee St (See Note 1)	28.07.2016	5/14	SW 208/16, WN 30
Glenroy	Glenroy Rd	04.08.2016	51/10	SW 225/16, WN 31

Note 1: The axle counters are only provided for Down movements on the East line and Up movements on the West line. This will not affect the bi-directional MTM train operations over this line section.

Signal Maintenance Technicians are required to reset the axle counter sections when Road/rail vehicles on or off track at these level crossings. Circular SWP 6/16 gives instructions on dealing with failed axle counter overlay sections.

A special symbol is used on signal diagrams adjacent to the level crossing to indicate axle counter overlays on existing signal systems.

24.06.2016 **Macaulay Stabling Sidings** **(SW 169/16, WN 26)**

Commencing Friday, 24.6., Sidings 3 & 4 will only be available to Comeng & Siemens trains (i.e. not X'trapolis) and Sidings 5, 6, & 7 will only be available to Siemens & X'trapolis trains (i.e. not Comeng). SW 298/13 (WN 41/13) is cancelled.

24.06.2016 **Rowsley Loop** **(SW 64/16, WN 26)**

From 0830 hours Friday, 24.6., No 2 Road was available for use. The operating restrictions in SW 46/16 will continue to apply. SW 49/16 is cancelled.

25.06.2016 **Caulfield – Moorabbin** **(SW 145/16, WN 26)**

On Saturday, 25.6., the level crossings at North Road (Ormond), McKinnon Road (McKinnon), and Centre Road (Bentleigh) were abolished. Down Automatics F413, F425, F441, F441P, F451, F467, F479, F493, & F505, and Up Automatics FM434, FM448, FM460, FM460P, FM474, FM486, FM486P, & FM502 were abolished.

Absolute Occupations were granted over the Down and Centre lines (O729/16).

Amend Diagram 65/12 (Glenhuntly – Highett)

(28.06.2016) **Defined station limits** **(SW 62/16, WN 25)**

When a Signallers Caution order (Form 2377) has been issued for a defective Home signal that leads to a section worked under the rules for Train Staff and Ticket, Double Line Block, or Train Orders on the V/Line network, the requirement to proceed cautiously to the next fixed signal will only apply within Station Limits. When the train is clear of the Station Limits, the speed is governed by the System Rules.

For sections worked by the Train Staff and Ticket, Train Order, or Automatic and Track Control Systems, Station Limits is the portion of line extending between opposing Home signals at that location. For sections worked by the Double Line Block System and Track Block System, Station Limits extends between the first Home signal and the Starting or Home signal leading to the next block section. For sections worked by Automatic Block Signalling, Station Limits extends between the first Home signal and the first Automatic signal in advance of the last Home signal.

When a wrong line movement is to be made within Station Limits, the Signaller must ensure that all fixed signals protecting the line over which the wrong direction movement is to be made are secured at Stop. All facing and trailing points which will be traversed in the wrong direction must be sleeved in the correct position, or a point sleeve or blocking command applied. Where the movement is a passenger train, and the points cannot be secured through the interlocking or by applying a sleeving or blocking commands, the facing points are to be secured by a point clip. The driver can then be given a verbal authority for the wrong direction movement. The verbal authority is to be given via a recorded radio, telephone, or in person.

SW 228/08 and SW 57/16 are cancelled.

(28.06.2016) Geelong (SW 67/16, WN 26)

Operating Procedure 61 (Geelong) was reissued. The main alterations concerned the operation of the single line release to South Geelong, and the operation of Home GLG160. SW 65/16 was cancelled.

(28.06.2016) South Geelong (SW 66/16, WN 26)

Operating Procedure 62 (South Geelong) was reissued. The alterations concerned the operation of the single line release to South Geelong, the provision of V/L signs in the Queenscliff Siding (SW 12/16), and the provision of dual control point machines. SW 17/15 was cancelled.

02.07.2016 Blackburn (SW 181/16, WN 26)

On Saturday, 2.7., temporary alterations were introduced in connection with the Blackburn Road grade separation project.

Baulks were provided 45 metres on the Down side of Home BBN310. Track circuit 306T was energised up. Points 206 were secured reverse. Homes BBN306 and BBN310 were secured at stop. A temporary 25 km/h speed restriction was introduced for all Down trains terminating in No 2 platform.

These temporary alterations were removed on Monday, 11.7.

(05.07.2016) Track force protection on two parallel lines (SW 70/16, WN 27)

Commencing forthwith when implementing track protection for parallel single or double lines, the track protection must be set up independently for each line. Separate track protection is to be in place for each of the parallel single lines, and where hand signallers are used, each hand signaller will only be responsible for providing protection for one line.

For a double line section placed under Absolute Occupation, protection must be provided for both lines at each end of the Absolute Occupation. The protection is to be set up independently for each line.

07.07.2016 South Dynon – Diesel Maintenance Workshops (Victrack Safeworking Notice 54/16, WN 27)

On Thursday, 7.7., Nos 5-11 Roads in the Diesel Maintenance Workshops, South Dynon, were booked out of service.

Points VTS22 were secured to lie for Diesel Maintenance Workshop No 4 Road. Points VTS21, VTS57, & VTS58 were secured to lie for the running road. The secured points were spiked and a collar and chain placed on the point lever. Baulks were provided on the broad gauge lead between Diesel Maintenance Workshop Roads 4 & 5. The Derails on the running road in the vicinity of diamond crossings VTS56 and VTS59 were secured off the rail.

(12.07.2016) Road/Rail operations (SW 72/16, WN 28)

Operating Procedure 134 (Road Rail Operations) was reissued. SW 169/15, NIPR2828, and NIWI2828.1 was cancelled.

(12.07.2016) Box Hill (SW 190/16, WN 28)

The route indicator on Up Home BOX315 can display:

- An illuminated left hand arrow for routes leading toward the Up line (Z track)
- An illuminated right had arrow for routes leading towards the Centre line (Y track), either directly or via the Up line (Z track)

12.07.2016 Tempy (TON 130/16, WN 29)

On Tuesday, 12.7., the Down end points were booked out of service.

(19.07.2016) Colac (SW 73/16, WN 29)

Permission is granted to use No 5 Road for empty car movements under the cover of an absolute occupation between Waurncoort Loop and Camperdown. Access to No 5 will be by the main line points at the Up end of the station yard which are secured by a point clip and padlock.

25.07.2016 **Hoppers Crossing** **(SW 171/16, WN 27)**

On Monday, 25.6., electro-magnetically latched pedestrian emergency gates were provided at Old Geelong Rd.

(26.07.2016) **Clayton – Pakenham** **(SW 209/16, WN 30)**

Diagrams 13/16 (Clayton – Springvale), 11/16 (Sandown Park – Yarraman), 9/16 (Dandenong – Hallam), 5/16 (Narre Warren – Pakenham) replaced 35/14, 105/13, 27/15 & 3/16 respectively.

01.08.2016 **Glenhuntly – Patterson** **(SW 145/16, WN 28)**

On Monday, 1.8., the section of line between Caulfield and Moorabbin was reopened for traffic. The new grade separate line between Ormond and Bentleigh was brought into use. Rail under bridges were provided at North Road (14.994 km), McKinnon Road (15.796 km), and Centre Road (16.596 km). New stations with 160 metre long platforms were provided at Ormond (15.023 km), McKinnon (15.841 km) and Bentleigh (16.472 km), however only McKinnon will be opened. Only the Down and Centre Lines will be in use.

The signalling between Glenhuntly and Patterson will be controlled from Caulfield. The panel at Caulfield and the TCMS screens at Metrol will be updated.

The following Automatic signals were provided: F418, FM418, F423, FM423, F428, F440, FM440, F445, FM445, F452, FM452, F459, FM459, F466, FM466, F473, FM473, F484, FM484, F493, F498, and F505.

Down Automatic F395 and Up Automatics FM530 and FM512 were altered and now only display Normal speed aspects.

Down Automatics FM397, FM515, F523, F535, FM535, and Up Automatics F512, MRN603 & MRN609 were restored to use.

All new signals, and existing Automatics F395, F512, FM512, FM530, are equipped with TPWS(TSS). All signals have LED heads. New ground level masts are tilt masts.

The speed of all Goods trains Caulfield – Patterson & Moorabbin – Mordialloc (in both directions) has been reduced to 40 km/h.

Diagram 1/16 (Glenhuntly – Highett) replaced 21/15

06.08.2016 **Prahan** **(SW 173/16, WN 31)**

On Saturday, 6.8., the existing pedestrian emergency gates at Greville St will be replaced by electromagnetically latched emergency gates.

08.08.2016 **Burnley** **(SW 212/16, WN 31)**

Between Saturday, 5.8., and Monday, 8.8., Points 215 and Crossovers 217, 235, and 277 were provided with M23A dual control point machines. The selector lever on these point machines will be secured in the motor position by signal maintenance padlocks and cannot be operated by train crews.

10.08.2016 **Berwick – Beaconsfield** **(SW 240/16, WN 33)**

On Tuesday, 9.8., and Wednesday, 10.8., the trap circuits were removed from the controls at Clyde Road, Berwick, and Station Street, Beaconsfield. SW 42/16, 67/16, and 68/16 are cancelled.

11.08.2016 **GIFT Siding, Morwell** **(TON 146/16, WN 33)**

On Thursday, 11.8., Points C at the Morwell GIFT siding was booked out of service due to fatigue in the V crossing. The V crossing has been replaced by plain track.

(16.08.2016) **Signal maintenance affecting point machines** **(SW 83/16, WN 33)**

When a Signal Maintenance Technician needs the points to be held in a specific position while performing maintenance, the technician must agree with Signaller as to the inhibits to be applied and when they are to be removed. The technician must inhibit the electrical operation of the point machine and ask the Signaller to apply a blocking command on the points.

(16.08.2016) **Dumosa** **(SW 82/16, WN 33)**

The siding has been abolished. The Up and Down main line points have been abolished. The point levers, Master Key locks, derail blocks, and intermediate siding board have been removed.

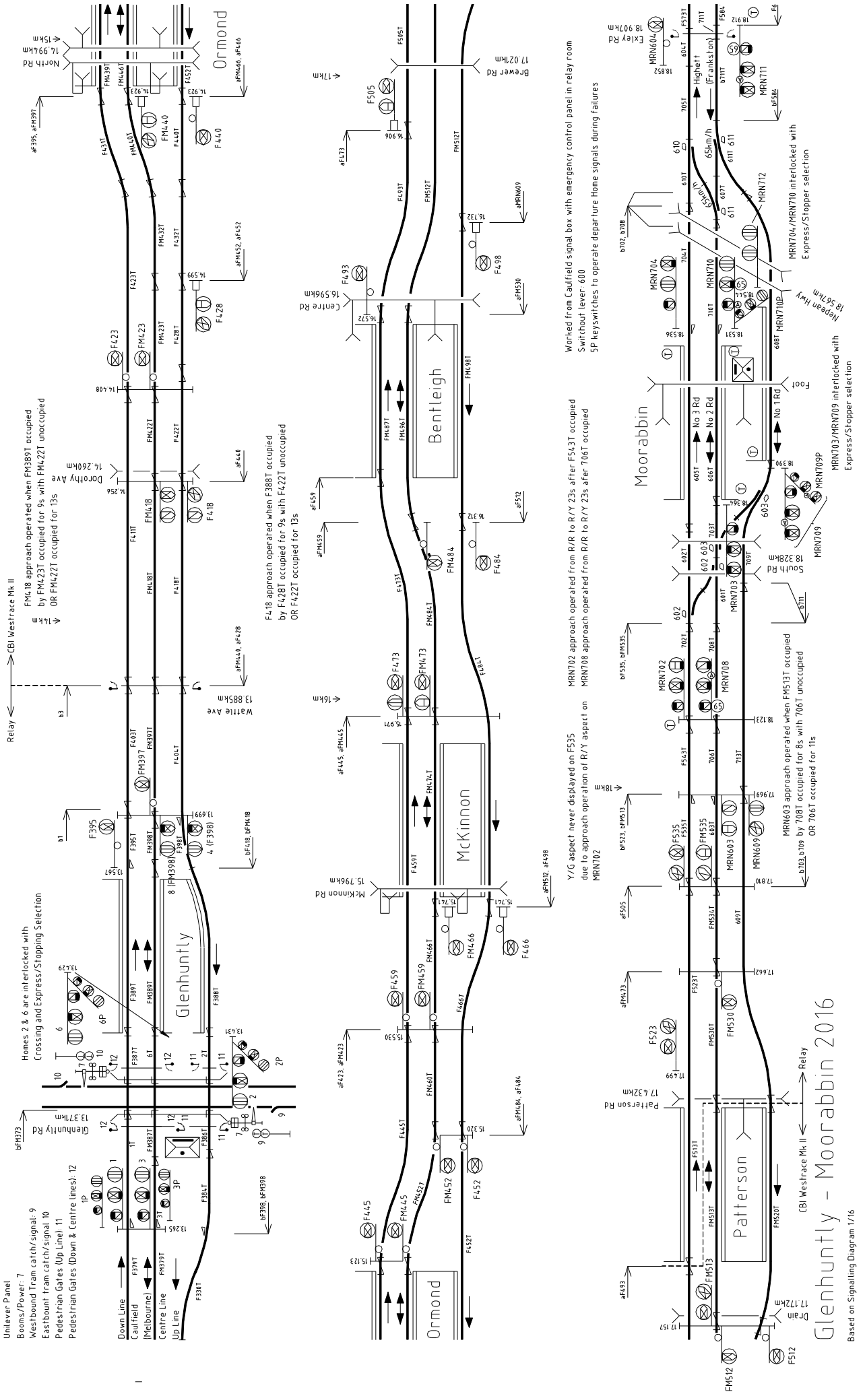
16.08.2016 **Pirron Yallock** **(SW 85/16, WN 33)**

On Tuesday, 16.8., boom barriers were provided at the passive crossing at Phalps Rd (163.886 km). Operation will be by a level crossing predictor and RRL predictor indicator boards are provided. Trains travelling at 50 km/h or more at the predictor boards may accelerate before reaching the crossing. Remote monitoring of the level crossing was provided, but not a healthy state light. Amend Diagram 118/14 (Birregurra – Colac). SW 78/16 is cancelled.

21.08.2016 **Marshall – Waurn Ponds** **(SW 79/16, WN 33)**

On Sunday, 21.8., pedestrian gates were provided at the Surf Coast Hwy (81.700 km). The gates are on the Down side of the road crossing. Amend Diagram 88/14 (Marshall).

End£


Glenhuntly - Moorabbin 2016
Based on Signalling Diagram 1/16
Unilever Panel
Booms/Power: 7
Westbound Tram catch/signal: 9
Eastbound tram catch/signal 10
Pedestrian Gates (Up Line): 11
Pedestrian Gates (Down & Centre lines): 12
Down Line
Caulfield (Melbourne)
Centre Line
Up Line
Glenhuntly Rd
13.377km
Glenhuntly
Homes 2 & 6 are interlocked with Crossing and Express/Stopping Selection
Relay
CBI Westrace Mk II
FM418 approach operated when FM389T occupied by FM423T occupied for 9s with FM422T unoccupied OR FM422T occupied for 13s
F418 approach operated when F388T occupied by F428T occupied for 9s with F422T unoccupied OR F422T occupied for 13s
Dorothy Ave
14.260km
Waitle Ave
13.885km
Ormond
North Rd
14.994km
15km
Bentleigh
McKinnon
Brewer Rd
17.102km
17km
Centre Rd
16.596km
McKinnon Rd
15.796km
16km
Moorabbin
No 3 Rd
No 2 Rd
No 1 Rd
Foot
South Rd
18.328km
Highett (Frankston)
Exley Rd
18.907km
Nepean Hwy
18.567km
65km/h
MRN704/MRN710 interlocked with Express/Stopper selection
MRN703/MRN709 interlocked with Express/Stopper selection
Worked from Caulfield signal box with emergency control panel in relay room
Switchout lever: 600
5P keyswitches to operate departure Home signals during failures
MRN702 approach operated from R/R to R/Y 23s after F543T occupied
MRN708 approach operated from R/R to R/Y 23s after 706T occupied
Y/G aspect never displayed on FS35 due to approach operation of R/Y aspect on MRN702
MRN603 approach operated when FM513T occupied by 708T occupied for 8s with 706T unoccupied OR 706T occupied for 11s
Patterson
Patterson Rd
17.432km
Drain
17.172km
18km

VR WOODEN SEMAPHORE MASTS

Andrew Waugh

There is a dearth of information on the wooden semaphore masts used by the VR. This article was inspired by a disintegrating mast located in a corner of the ARHS museum at Newport. Additional information has been based on the wooden mast located at the Coal Creek historical park at Korrumburra; it's likely that this mast is an original VR mast and not a recreation. This article is intended as a conversation starter to see what other information members might have, or knowledge of other original VR wooden masts or parts still in existence. Details are therefore subject to change!

History of wooden masts

Ignoring the very early three position signals, it appears that wooden masts were installed new on the VR roughly in the period 1876 and 1910[1].

Wooden masts were definitely used as part of the first VR interlocking installation at Essendon Junction on 1 July 1876. Those masts were recorded as being of Oregon pine up to 50 feet in length. The bottom portion of the mast was cased in 3" red gum planking which extended 3 feet above ground level. The masts were supported by two red gum sills, each 12 feet long, arranged in a cross and buried 5 feet below ground level. These masts appear to have been supplied complete by McKenzie and Holland, and this practice appeared to continue until mid 1881.

From June 1881 the VR commenced to purchase semaphore fittings from jobbing foundries. It is likely that these fittings were for masts at non-interlocked locations, with McKenzie and Holland continuing to supply the semaphore masts provided as part of installing interlocked signal boxes. This would have required the Department to supply the masts themselves, but no contracts are known for the supply of masts at this date.

In 1887 the Department tendered for the supply of interlocking material to be manufactured in Victoria. McKenzie and Holland won this contract, and subsequent contracts, until around 1910. These contracts did not include the semaphore mast themselves, only the fittings, and so the VR must have been supplying the masts at this date.

However, no contracts are known for the supply of semaphore masts until June 1894. Thereafter, contracts followed at irregular intervals with the last apparently being let in August 1908. These contracts are specifically for semaphore masts, and it would appear likely that the contract was not just for the supply of a log from which a mast could be cut, but was for the squaring of the mast into the tapered form. It is possible that prior to June 1894, the Department manufactured the semaphore masts itself from logs.

Drawings for lattice masts exist dating from around 1910, and it is likely that the manufacture of new wooden masts ceased around this time. Figures from calculation books dating from this time show that wooden masts were heavier than lattice masts, and, at least in the taller examples, more expensive. In August 1912, The Argus noted that "The replacement of wooden semaphore masts by mild steel latticed mases has been proceeded with the object of effecting economies in renewal."

Despite the VR manufacturing semaphore masts from at least 1881 to 1910, the former S&C plan system does not appear to contain any plans showing the details of wooden semaphore masts. This may be because the plan system was not set up until around 1917, and, by this time the plans had been discarded as construction of new wooden masts had ceased by that date. It is possible that the plans of wooden masts survive in the contract plans formerly held in the plan room. These drawings are not currently accessible, however.

Wooden mast details

Measured details of the wooden mast at the ARHS museum appear in the diagram on the following page. Some details have been added from a mast erected at the Coal Creek Historical Park, Korumburra, which appears to be an original VR mast.

Some care needs to be taken with the measured dimensions given in this article. First, only one mast has been measured and it is consequently not known how typical this mast is. The post at the ARHS museum is in poor condition, with the mast sprung, and the top rotted and difficult to access, even though it is lying on its side. It is, of course, difficult to measure the top of an erected mast. Finally, it should also be remembered that precise dimensions were not critical in the preparation of a wooden mast. A difference in a couple of inches in the height, or half an inch or so in the width was unimportant.

Imperial dimensions are used this article, reflecting the system in use when the masts were designed and used.

Overall mast dimensions

The total length of the ARHS mast is 27'5" and it is divided into two parts; a butt that was largely buried in the ground, and the mast proper.

Contracts let between 1901 and 1908 for semaphore masts were for the following lengths: 28', 30', 33', 35', 38', 40', 43', 48', and 56'. The common lengths required in the contracts were of the 28', 33', 38' and 43' lengths. A 1912 calculation book gives the following standard heights for wooden masts as: 15', 20', 25', 30', and 35'. As discussed later, the height of a semaphore mast is measured from the top of the base (butt) to the centre of the topmost arm.

It is likely that the ARHS mast is a (nominal) 28' length, with a specified height of 20'. The eight foot difference is mostly the length of the butt, and the height of the mast above the centre of the topmost arm.

The butt

The butt of the ARHS mast is 5'9" long, parallel sided, and roughly squared. It is nominally 16" on each side, but the original tree trunk was not large enough to take this

[1] The history is based on 'Semaphore Masts in Victoria', Andrew Waugh, Somersault Vol 24 No 6 (November 2001), p105-7

dimension all the way to the corners, and so the corners are rounded.

Although the butt was largely buried, the top ten inches or so was above ground level.

The butt has evidence of below ground bracing. Each of the visible sides has a housing for a brace. Each housing is 10" long by 5" wide and is roughly 1¼" deep at the top. The bottom of the housing is 47" (3'11") from the bottom of the butt. The braces would have rested on a foundation, probably two timber sills under the base of the mast.

The mast

The portion of the ARHS mast above the but is 21'8" long (including the spigot for the finial). It is squared and tapers uniformly on all four sides from 7" square at the top to a nominal 12" square (one side is actually 13") at the top of the butt. There is consequently a significant step at the top of the butt. A 1955 VR plan for providing steel base support for wooden masts (A1254) states that the standard taper was approximately 1/8" per foot; this matches the calculated taper on this mast.

The 1912 calculation book states that all masts were 9" square at the top. Masts 25' and under were 12" square at the butt, taller masts were 13" square. It is possible that the dimensions had increased towards the end of the timber post era.

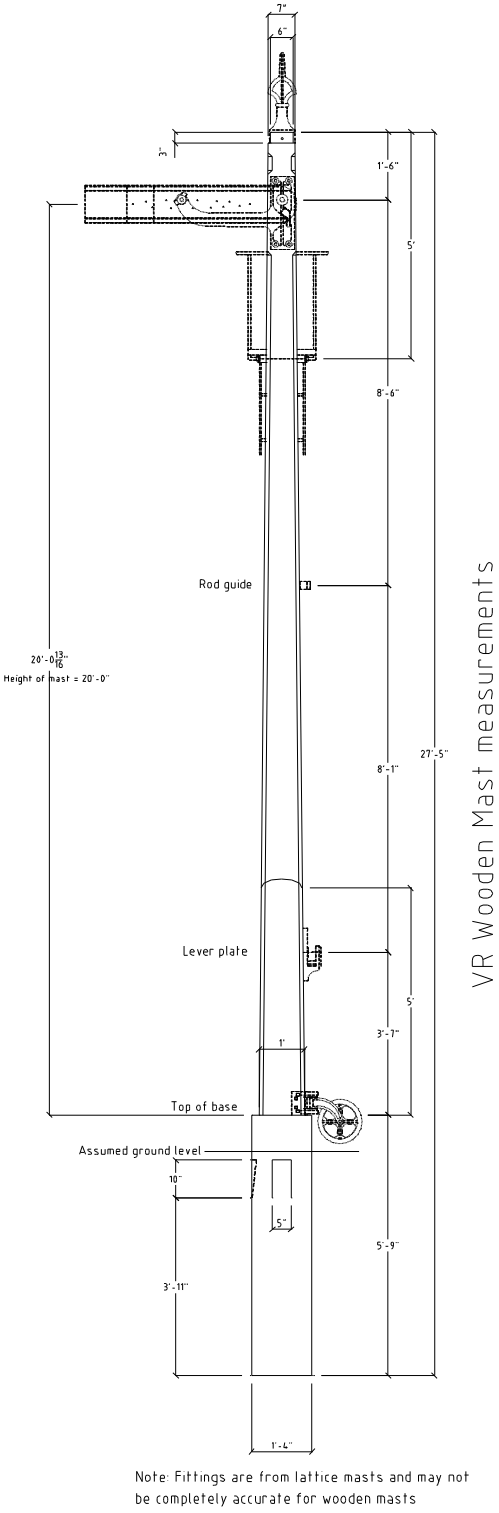
Interestingly, Rayner-Wilson, around 1905, states that "The general size [of timber posts in the UK] is 7 in. x 7 in. at the top, increasing at the rate of about 1/8 in per foot, and 12 or 14 in. square at the bottom."[2]

The finial

The very top of the wooden mast forms a spigot on which the finial is mounted. The spigot is 6" square and 3" tall with a chamfered top edge[3]. The finial was secured to the mast using ½" coachbolts.

Normally, a wooden post had a McKenzie and Holland finial, but a number of wooden posts existed with 2B936 finials (as used on lattice posts). It is possible that masts with the 2B936 finials were erected towards the end of the wooden post era when the VR had commenced producing its own signalling equipment.

The finial served an important function on a wooden post as it prevented water getting into the end of the post and causing it to rot. The fancy design of finials simply reflected the design aesthetics of the period; the roofs of buildings, telegraph poles, and even fence posts were all finished off with a finial.



The arm

It would appear that the mast in the ARHS museum is for a single armed home (or distant) signal. On the mast in the ARHS museum the spindle hole for the somersault arm is 18" below the very top of the mast.

It is likely that this was the standard location for the topmost arm as the chamfering would fix the position of arm once the post was fashioned. It is interesting that while the drawings of a lattice mast do not give standard location for the arm – it's even easier, of course, to move an arm on a lattice mast as the arm is simply clamped to the mast - the standard position of the arm on a lattice mast was also around 18" below the very top of the mast.

The arm bracket for a wooden mast (2B615) was secured to the front of the mast using four ¾" bolts that extended through the mast, and the back bearing by four 5/8" coachbolts.

The quoted height of a semaphore mast on the VR is from the top of the base (butt) to the centre line of the topmost arm. On a semaphore arm, the spindle is 1 3/16"

[2] Mechanical Railway Signalling, H Raynar Wilson, p44.

[3] The socket on a Type A finial (3B936), as mounted on the post at Coal Creek, is 6 ¼" square on the inside and just over 3" deep. The socket measures 6 7/8" square on the outside, so the post is very slightly larger than the finial.

above the centre line of the arm. This means that on the ARHS post, the arm was 20′1″ above the base.

Landing & ladder

The holes to secure the access landing are around 60″ (5′0″) below the very top of the mast, or around 38″ (3′2″) below the arm centre line. Again, this is roughly the same as on a lattice mast.

Unfortunately, I have not been able to measure a landing or safety hoop. The details in the drawing are based on the standard VR signal landing (3B937), handrail (8B802), and ladder (7B937). Interestingly, these give results that appear almost identical to the post at Coal Creek. Indeed, the design for the signal landing appears to have provision for securing to a wooden mast (two 11/16″ holes spaced 4″ apart).

Chamfering

Wooden masts are stop chamfered[4] on all four edges. Chamfering makes the edges of the mast less susceptible damage by impacts, and make it less likely for people to get splinters from the corners. At the top of the mast there is a short section of chamfering between the finial and the arm bracket; this section has the same length on all four sides. The chamfering on the back of the post restarts immediately below the back bearing, while the chamfering on the front of the post restarts below the bottom of the arm bracket.

Other mast fittings

In addition to the arm and landing stage, a semaphore mast is fitted with a swivel wheel at the base of the mast for the wire lead, a lever plate, and one or more rod guides. Again, I have used the standard VR fittings on the drawing.

The swivel wheel is mounted just above the step marking the boundary between the butt and the mast itself. As the swivel wheel extends below the mounting plate, this means that the butt must extend about 10″ or so above the ground level.

The pivot on a lever plate is about 43″ (3′7″) above the base. The plate not mounted on the centreline of the mast, instead it is mounted flush with the front of the mast. This is required due to the run of the down rod.

The mast at the museum has one down rod guide, and this roughly half way between the lever plate pivot and the arm spindle. It is likely that where more down rod guides are provided this distance was equally divided amongst the guides.

Painting

In 1910, the instructions for painting semaphore masts were:

> Every semaphore masts must be painted white from a line 5 feet above the ground to the top, and black from that line to the ground, unless special instructions are given to paint it dark grey. All fittings, such as lever plates, rod guides, down roads, brackets, cranks and blinders must be painted black. (Instructions 514, 1910 Way and Works Branch Instructions)

This instruction was repeated in the 1924 W&W Branch instructions.

The ARHS mast had lost all of its paint, but it is interesting that the Coal Creek mast conformed to these instructions. The division between the black and white portions of the mast was rounded off, but the lowest portion of the division was five feet above the base.

(Below) Looking up the ARHS mast from the base of the butt. The change from the roughly squared butt to the squared mast is clearly visible. Also visible are the housings cut into the butt to take the underground braces. The metal casting is the remains of the lever plate.

[4] Stop chamfering means that the chamfer stops before the end of the piece of timber. This gives a neat, simple finish that is cheap to produce.

Three views of the wooden semaphore mast at Coal Creek, Korumburra. The durability of the Victorian hardwoods can be judged by the fact that this mast would be over 100 years old.

Starting from ground level, the first point to note is that the butt of the mast protrudes about 10″ above ground level – although this might be further than originally intended due to a relocation of the swivel wheel.

A swivel wheel is fitted to the rear righthand corner (facing the mast). The chain wheel converts the horizontal pull of the wire lead to a vertical pull of the lever. A swivel is usually provided to accommodate different approaches of the wire lead. The swivel wheel is secured to the mast immediately above the base. As the wheel hangs below the securing plate, this means that the top of the butt is above ground level. Note that on this mast about 5″ of the side and rear of the butt has been adzed flat to allow the swivel wheel to be mounted lower than originally fitted.

The lever plate is mounted with its edge adjacent to the front of the mast. This allows a straight drive of the down rod, as can be seen in the rightmost photo. One or more down rod guides are fitted to ensure that the rod doesn't buckle when the signal is cleared. This mast has two rod guides, while the mast at the ARHS museum has only one.

The bottom portion of the mast, to five feet from the top of the base, is painted black with the remainder painted white. As seen here, it was common for the top of the black portion to be curved.

Two views of the top of the mast at Coal Creek.

The finial is the type more usually used on lattice masts (2B615). This type of finial was not uncommon on wooden masts, possibly this type of finial was used on those wooden masts provided towards the end of the use of wooden masts. Notice how the base of the finial is slightly smaller than the top of the wooden mast.

The heavy arm bracket on the front of the mast is secured to the mast using four bolts that extend all the way through the mast - the top two bolts can be seen above the back bearing, while the bottom two bolts can be seen immediately above the safety hoop.

The much lighter back bearing is secured to the mast using coach bolts (i.e. bolts that simply screw into the mast and do not go all the way through the mast).

The edges of the mast are cut away for a part of the distance between the finial and the arm; this is known as a chamfer. A stop chamfer is where the chamfer does not extend the full length of the timber (as here). The section of the mast immediately under the finial and in the vicinity of the arm are full section. The chamfering begins again below the arm. On the front of the mast the chamfering starts just above and below the arm bracket. On the rear of the mast, the chamfering extends much higher – to just below the back bearing.

I have very little information about the access ladder and landing. One point to note here is that the landing appears to have been raised several inches at some stage; there are two holes immediately below the landing, and a number of holes below the where the handrail is secured. It is most likely that the landing was relocated when the mast was re-erected at Coal Creek.

The lamp support is not directly secured to the semaphore mast. Instead, it is supported by a steel bar secured by the same bolts that secure the top of the arm bracket.

Finally, note that despite the painting instructions calling for all fittings to be painted black, most of the fittings are, in fact, painted white.

GALVIN ACCIDENT

Around 7.01 pm on the evening of 22 August 2014, a V/Line VLocity set running empty cars from Geelong ran into the rear of a MTM Comeng train near the former station of Galvin on the direct line to Newport on the Down side of Laverton. Both trains were extensively damaged, but no serious injuries were reported. The ATSB has released the report into the accident[5].

Background

The accident occurred at night, about an hour after sunset. The weather was fine and clear. It happened on a straight section of three track main line (two bi-directional electrified broad gauge lines, and a standard gauge freight line). The two broad gauge tracks were signalled using colour light signals under the rules for Automatic and Track Control. The controlling signal box was at Newport, however the signaller there did not have a complete view of the track occupancy at the accident location. There are large oil refineries on the horizon at this point, and the bright lights associated with these make it difficult to see relatively dim lights on the railway.

The accident

MTM train 6502, a six car Comeng set consisting of 338M-1092T-484M-487M-1052T-427M, departed Werribee at around 1840 on a scheduled service to Melbourne. Shortly after passing Up Automatic GG630, near Cherry Creek between Laverton and Altona Junction, the driver heard a loud bang from under the train. The brake pipe pressure fell and the brakes applied. Not knowing what was wrong, the driver moved the brake handle to the full service position. The train came to a stop at 1855 with the rearmost car around 16.53 km. After looking back to confirm that the train had not derailed, the driver contacted Metrol for authority to go onto the track to conduct an inspection of the train.

Following the MTM train was V/Line train 8280, an empty cars service from Geelong to Southern Cross. This consisted of VLocity DMU sets VL05 (Units 1105-1205), VL12 (Units 1112-1212) and VL39 (Units 1139-1339-1239). After passing Laverton it passed Automatic GG672 displaying Normal Speed Warning (Yellow over Red) at around 90 km/h. The train came to a stand at Automatic GG630, which was at stop (Red over Red) as the MTM service was standing in the section ahead.

Three seconds after coming to a stand at GG630, the driver applied power and Train 8280 passed GG630 at stop. The V/Line train accelerated to a maximum speed of 43 km/h after passing GG630. The driver made an emergency brake application 1.4 seconds before the collision, but there was no time to reduce the speed before the train collided with the rear of the MTM train.

The MTM train was pushed forward about 30 metres due to the collision. Both trains were extensively damaged in the collision. The driver of the MTM train, the driver and conductor of the V/Line train, and eight passengers on the MTM train sustained minor injuries.

Passing an automatic signal at danger

Victorian rules allow the passing of an automatic signal at stop without obtaining permission from the signaller. The rules require the driver to bring the train to a stand at the signal. If the signal is still at stop after 30 seconds, the driver can proceed but must travel at extreme caution and be prepared to find the track occupied, obstructed, or damaged. Extreme caution is defined as slow enough to be able to stop the train in half the distance that can be seen ahead. However, the speed must not exceed 25 km/h or the posted track speed (whichever is lower).

The report notes that in NSW, the action of the driver at an automatic signal at stop depends on whether the driver can see if the block section in advance is obstructed. If the block section in advance can be seen to be obstructed, the driver must get permission from the controlling signaller to pass the signal. If the block section can be seen to be not obstructed, the driver can pass the automatic without communicating with the signaller. If the whole of the block section cannot be seen (as was the case in this accident), the driver must try to speak with the signaller. If the driver cannot contact the signaller, the driver may pass the signal at stop without permission. After passing an automatic at stop, the driver must travel at restricted speed and not rely on assurances that the block is clear.

In Western Australia, the driver must obtain the permission of the Train Controller to pass any automatic (approach) signal at stop. If the driver cannot contact the train controller, the driver can pass the automatic signal after one minute. The driver must then proceed cautiously.

Although not discussed in the report, the Code of Practice for the Defined Interstate Rail Network (DIRN) used by ARTC requires a train crew to contact the train controller at any signal that is at stop. The train may only pass a signal at stop after receiving a train authority from the train controller. The train authority will include any instructions required, such as the maximum speed through the section. If the driver cannot contact the Train Controller, the train must remain at the signal until it shows a proceed indication.

Comeng marker lights

The final defence against a rear end collision is the tail lamps on the rear vehicle. Each Comeng motor car is fitted with two red lights above the cab windows which are illuminated as tail lights. The tail lights were working at the time of the accident.

In 2007, the Rail Industry Safety and Standards Board (RISSB) developed an Australian Standard (AS 7531.2:2007) "Railway Rolling Stock Lighting and Rolling Stock Visibility". This states that "If operating in a network where the Safeworking System allows Permissive

[5] Available at https://www.atsb.gov.au/publications/investigation_reports/2014/rair/ro-2014-016/ Note that the ATSB refer to the location of this accident as Altona, which is somewhat misleading as Altona station is located some two kilometres south of the accident site on a completely different railway line.

Working[6] then each tail light shall have a luminous intensity of at least 100 candela'. A new marker light of the type fitted to the Comeng train was tested, and gave an approximate luminosity reading of 33 candela. A Siemens train marker light has a luminosity of 30 candela, and an X'Trapolis 200 candela. MTM have adopted the RISSB standard, but have not implemented it across their rail fleet.

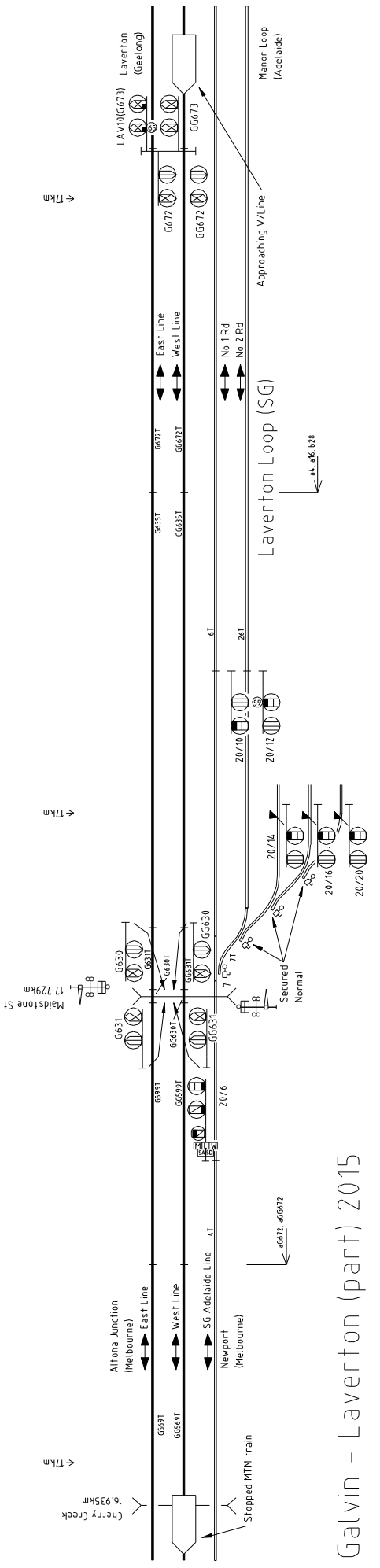
After the accident, night time tests of the Comeng tail lights were carried out at the incident site. It was noted that the tail lights were hard to see due to the refinery lighting and the bright LED signals.

Communications

Suburban MTM trains and V/Line trains cannot directly speak to each other by radio. Nor can MTM trains communicate with Centrol, nor V/Line trains with Metrol. Neither Metrol or Centrol can see the state of the tracks, signals and trains in this area. The track is controlled by the Signaller Newport, but only partial indications are provided to the Signaller as to the state of the section.

Conclusions

The ATSB concluded that the immediate cause of the accident was that the driver of the V/Line train proceeded after passing a signal at stop at a speed that reduced the opportunity to observe the train in front and stop in time. They highlight that the rules for passing an automatic signal at stop place sole reliance on the train driver to provide separation between trains by line of sight observation. This is the least effective defence against human error or violations where no other risk mitigation strategy is in place. The ATSB recommended that MTM consider additional risk mitigation measures to maintain train separation in these circumstances. The ATSB also recommended that MTM improve the visibility of tail lights to an appropriate standard.



[6] That is, trains may pass automatic signals at danger without permission from a signaller.

1890 TELEGRAPH HANDBOOK

(Continued)

Electric Bells and Semaphore Repeaters

There are two kinds of electric bells – the trembling and the single-stroke or Ragon bell. The former are most extensively used, both for office communication and for train signalling purposes. The latter kind are used in connexion with the block instruments.

Fig 12. *A* is a horseshoe magnet, *B* is the armature to which the hammer is attached, *C* is the contact spring, *D* the bell, E^1 and E^2 the terminals of the bell, *F* is the battery, and *G* the press button.

When the circuit is closed at *G*, the current flows through the coils of the electro-magnet *A*, which becomes magnetised and attracts the armature *B*; *B* being drawn away from the contact spring *C*, the circuit is broken, the current ceases to flow, and the electro-magnet loses its magnetism and allows *B* to resume the contact with *C*. The circuit is now closed again, and the same operation goes on as long as the press button is pressed.

Where there are several bell circuits converging to one point it is only necessary, by employing an indicator, to have one bell. There is a shutter for each bell circuit in use. There is hardly any limit to the number of shutters that may be used. It is an easy matter to arrange for as many as a hundred shutters in one indicator.

When the button is pressed in any room, and the circuit is closed, the bell rings, and the shutter corresponding to the number of the room falls and remains down until it is replaced by the person who attends to the indicator. Fig 13 shows an indicator having three shutters. *A* is the bell, *B* is the battery, *1*, *2*, and *3* are the shutters corresponding to the press buttons *1*, *2*, and *3*. *A* wire from each press button is connected to one terminal of the battery. The other wire from the button is connected to the terminals of the shutter coils *1*, *2*, *3*. The other terminal of the shutter coils is connected to *B4*, which is connected through the bell to the battery.

The circuit of *1* is from the press button to connecting screw *1*, through shutter coil *1* on to *B4*, through the bell and battery back to the press button. The other circuits, *2* and *3* being open, they are not affected by the current passing through one; but if they are affected, there must be a fault somewhere.

The fault may be caused by the wires of the two circuits touching somewhere. If the wire leading to the connecting screw *1* touched the wire leading to the screw marked *2* when either button was pressed, both shutters would drop, the current dividing – one-half going through one shutter coil, and the other half going through the second shutter coil, that, of course, is assuming that the resistance of each is the same. If the bell continues ringing, there may be a short circuit somewhere along the wires, or at the contact points of the press buttons. When the bell does not ring but the shutters fall all right, the bell is either out of adjustment, or the hammer is jammed somehow. In a case where the bell rings but the shutter does not fall, the shutter will be found to be out of adjustment, this can be rectified by bringing the armature near the cores of the electro-magnet. This fault may, however, be due to the short circuiting of the shutter coils. When the bell and shutters both fail to act, the fault will probably be found in the battery or in the connections between the bell, the battery, or the indicator, that is, between *A* and the indicator, between *A* and *B*, or between *B* and the press buttons *1*, *2*, *3*. To test the bell, join a wire to *Z* and connect to *B4*, the bell should then ring, and if it does not the fault must be either in the batter, the bell or the connecting wires. If the bells acts during that test, but does not when the buttons are pressed, the fault will be either between the battery and the buttons, or between *B* and the shutter coils.

For train signalling it is necessary to arrange the bell circuit so that rings may be sent as well as received. For this purpose, a key is used similar in principle to that used for telegraphic purposes, although the construction is by no means the same, the electric bells being worked on the silent system, that is, the bell at the sending end does not ring when a signal is being sent. Fig. 14 shows two bells connected up with keys. *A* is a brass plate connected to the battery; it is insulated from *b*, the line spring – which is generally made of German silver – *b* is separated from *c*, another brass plate, by a piece of ebonite, but makes contact at its lower end by means of a little stud. A wire leads from the plate *c* to the bell, the other terminal of which is connected to the earth. One terminal of the battery also goes to earth. To send a ring from A to B the spring *b* is pressed against plate a, the circuit is then from the battery to plate *a*, on to spring *b*, out to line, along the line, and on to line spring *b* at B, across the little stud to bell plate *c*, and from that to bell, thence to earth. When the line spring *b* is pressed against *a*, the contact between *b* and *c* is broken if it were not so the bell at A would ring also. The battery at A rings the bell at B, and vice versa. In bell circuits arranged in this manner there are several faults that may occur which, perhaps, may only affect one of the bells. If A is able to get signals from B, but B is not able to get signals from A, the fault may be owing to the line spring *b* at B not making good contact with the bell plate *c*. The wire between the plate *c* and the bell may be broken, or the wire between the bell and the earth; or the fault may be in the key at A, the platinum contact having perhaps, been knocked off. Lastly, the fault may be in A's battery. To get an idea of the state of the battery connect *c* and *a* by a screw-driver, or other convenient tool; if the bell rings sharp and brisk it is a pretty sure sign that the battery and the connexions between it and the bell are all right. This should not be taken as a final test, but just as a short of feeler. When a signal cannot be sent either way, the fault will probably be a line-wire, leading-in, or earth wire broken. It is quite possible that such a fault would occur through the two batteries going wrong at the same time, but it is not at all likely. A fault of this description might also be due to the line being to earth at some point between the A and B. In intermediate boxes the state of the battery may be ascertained by inquiring on the telephone if the box on the opposite side is able to get rings from the box in question. This, if A is a terminal, B

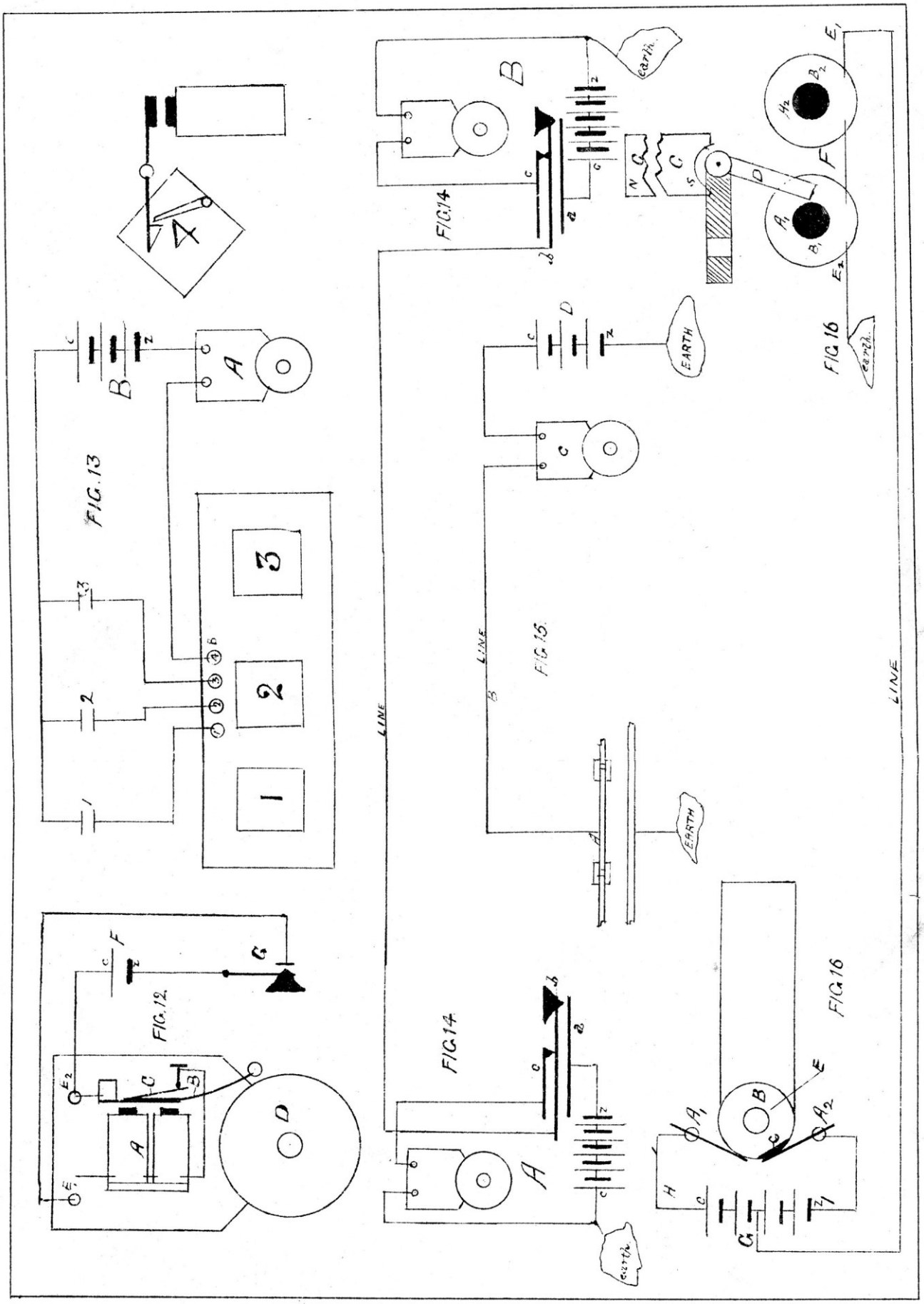


FIG. 13
FIG. 12
FIG 14
FIG 15
FIG 16
FIG 16
LINE
LINE
LINE
EARTH
EARTH
Earth
Earth
A
B
C
D
E
F
G
1
2
3

an intermediate, and C a terminal box, and A and B work together all right, although B and C are unable to work, that is sure sign that B's battery is in working order. The fault will be found in the line-wire, leading-in, or earth wire.

There are a few faults to which the bell itself is liable, the most common being the burning of the contact points. When this is found to be the case they should be cleaned and polished. Sometimes a bell-hammer strikes the bell once when a signal is being received, and sticks. This is caused either by the adjusting spring being too tight to allow of the contact being broken, or the armature touches the cores of the electro-magnets. The armature should not be allowed to touch the cores. There should be sufficient space to allow a piece of paper to be passed between the armature and the cores when the hammer is pressing against the bell.

Ground Bells.

The method of arranging the ground-bell circuit on our lines is to insulate a rail at the point desired by taking off the fish-plates by when the rails are usually connected, and substituting wooden blocks, cut so as to fit on to the side of the rails. The great desideratum of a ground bell is to have a well insulated rail. On this depends, to a very great extent, the efficiency of the bell. In some places it is hardly practicable; for instance, where the line is laid in low-lying damp ground.

Fig 15 shows the circuit of an electric ground bell. *A* is the insulated rail to which the line-wire *B* is connected, *C* is the bell, one terminal being connected to the line-wire *B*, and the other to the battery *D*, and thence to earth. The only gap in the circuit is between the insulated rail *A* and earth rail *E*. (It is always advisable to put an earth-wire on to the rail opposite the insulated rail.) When a train passes over the insulated rails the wheels and axle form the circuit closer, and the bell continues to ring during the time the train is passing. The line-wire is connected to the rail by means of a bolt and copper washers, the rail being first bored, and the metal round the hole made clean by filing or chipping off some of the metal with a cold chisel. If the rail is properly cleaned, and the bolt screwed tightly when the wire is first put on, it will not require cleaning for several months. Where it is practicable, it is a good plan to connect the bare wire on to the rail, as a fault is at once observable. The insulated rail must be always kept from the ballast, especially where gravel or ashes are used. If any is allowed to touch the rail, the bell will ring continuously. The battery and bell being at the same end of the line-wire, anything which puts the line-wire to earth causes the bell to ring.

In one or two places, for the sake of convenience, the battery is placed between the line-wire and the insulating rail. An earth fault in such a case would not manifest itself by ringing the bell; the current would be escaping only when the trains were passing over the rail, and, probably, sufficient would not pass the leakage to ring the bell. The galvanometer would have to be used to detect the fault. For testing purposes it is better to have the bell and the battery at the same end of the line. It is generally very slow work testing for a fault in a ground bell, so much time is occupied in walking from the place where the bell is to the insulated rail, and then having to wait till a train passes to see if it rings. The most common faults in ground bells are the wires at the rail getting broken, and the contacts at the rail where the wire is connected becoming rusty from the moisture. The contact points of the bell itself have to be carefully looked after. The contact points of a ground bell become sooner burnt away than those of the ordinary electric bell, and they ring for a longer time at each ring.

When a ground bell stops ringing altogether, and the tester satisfies himself that the bell itself is all right by putting the bell to earth at the line terminal, the fault must be looked for either at the leading-in, line, or earth wires. The connexions at the rail must also be seen to. To save time in testing, it is a good plan to connect the line and earth wires together at the insulated rail. The leading-in and earth wires and battery can then be tested without waiting for a train to pass over the insulated rail. If the bell rings when this is done, it is a sign that the connexions at the rail are dirty.

A curious fault in a ground bell came under notice two or three years ago. The bell had stopped ringing altogether. The fitter examined the battery, tested and localised the fault to the wire leading to the rail. The wire was insulated, and for protection was run through an iron pipe. The wire, when pulled out, was found to be eaten away for several inches. Some water had lodged in the pipe and electrolytic action had been going on between the copper wire and the iron pipe. The copper plate of the battery was connected to line, and the copper of the wire was deposited on the pipe. To prevent the above, it is best to connect zinc to line.

Repeaters.

The repeater is an electrical contrivance to show the position of the semaphore arm when the semaphore is out of sight of the signalman. Its most important function is to show reliably when the signal is at danger. For this purpose the miniature arm of the repeater must be kept in the danger position by an electric current, the circuit being closed by the semaphore arm when it goes up to danger. It is most essential that the repeater should show the danger signal when the semaphore arm is at danger. There is more likelihood of an accident occurring through a signalman believing his signal to be at danger when it is at the all right than vice versa. Semaphore repeaters are generally fixed on distant semaphores.

Fig 16 shows the coils, &c., of a repeater. A^1 and A^2 are the coils, B^1 and B^2 are the pole pieces, *C* is a large permanent magnet, *D* is the armature – one end being pivoted to a piece of brass attached to the permanent magnet *C*, the other end being pivoted to the small semaphore post. The miniature arm is fixed on the spindle, so that when the armature is over against one pole o the electro-magnet it shows the danger signal, and when it is over to the other pole it shows the "all right" signal. E^1 and E^2 are the terminals of the coils.

The circuit closer now in use is arranged by fixing a brass ring or disc, about three inches in diameter, on the spindle by which the semaphore arm is supported. A segment of ebonite is let into the brass disc. Two German silver springs are fixed, so that when one is making

contact with the disc the other is pressing on the ebonite portion. Fig 16 shows the circuit closer, battery, and repeater. A^1 and A^2 are the German silver springs, *B* is the brass disc which is connected to the earth, *C* is the segment of ebonite, *D* is the earth wire, *E* the line wire, *F* the repeater, *G* the battery, *H* is the wire leading to the top contact spring A^1, *I* the wire leading to the lower contact spring A^2. The line wire *E* is connected on to the middle of the battery. When the semaphore arm is at danger, the circuit is from *D* to *B* on to the top contact spring A^1, along the wire *H* to the battery, through two cells of battery on to the line wire *E*, to the repeater, and then to earth. When the semaphore is pulled down to "all right," *B* is turned round till the bottom contact spring makes contact, and the top spring then presses on the ebonite. The circuit is then from *D* to *B* on to the bottom spring A^2, along the wire *I* to the battery, through the battery to the line wire *E*, to the repeater, and to earth. The current this time being in the opposite direction, the magnetism in the cores is reversed, the armature goes to the opposite side, and the miniature arm shows "all right," corresponding with the semaphore.

The present form of repeater can be worked with two or three cells of the Meidinger battery for each circuit; whereas with the old form six cells were required. The new style of circuit closer is also a great improvement, as the springs are no so likely to be broken. The repeater itself is not likely to get out of order, the lightning being about the greatest cause of trouble. The battery, line, and earth wires generally furnish the causes for faults. If the miniature arm drops when the semaphore is known to be in danger, the fault will be due to a week battery or a bad earth. If the repeater shows "all right" (sic) when the semaphore is pulled down to "all right," it is a sign that the earth and line wires are all right, and the fault must be looked for in the battery or the wire between the battery and the top contact spring A^1. In a case where the repeater shows the danger signal when the semaphore is pulled down to "all right," the repeater must be examined to see that the armature is not touching the permanent magnet. The line wire should also be examined to see that no other wire come in contact. The top contact spring of the circuit closer should break contact with the brass part of the disc when the semaphore arm is lowered. If it does not do so, the repeater will not show "all right."

The repeater will show three positions – the "danger" when the semaphore is at danger, the "all right" when the semaphore is set at "all right," and a position between those two when the semaphore arm has been pulled down, so that the top contact springs breaks circuit, but it is not far enough to make circuit with the bottom contact. The repeater arm will then be at an angle of 30 deg. to the miniature post. The connexions on the circuit closers of repeaters, like those of the ground bells, being so much exposed to the weather, &c., require exceptional vigilance on the part of those in charge of them.

(Below) One of the interesting features of the new grade separation between Ormond and Bentleigh is that all of the new signals are fitted with both train stops and TPWS(TSS), as shown here at Up Automatic FM466 at McKinnon. The complete provision of TPWS(TSS), including at Automatic signals, is understood to be the new standard wherever both V/Line and MTM rolling stock runs. A train stop TPWS installation consists of two loops mounted next to each other. When the adjacent signal is at stop, both loops are energised. A TPWS equipped train passing over the first loop detects it and starts a counter running. The brakes are applied if the train detects the second loop before the counter runs out. Since the two loops are located next to each other in a TPWS(TSS) location, the second loop will always be detected before the counter runs out and the brakes applied.