-- SIGNALLING RECORD SOCIETY (VICTORIA) --

-- SOMERSAULT --

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Editor: David Langley, 20 Alfred Street, Seymour, 3660.

In this issue is a semi-technical article written by John Sinnatt on track circuits as used by the Victorian Railways. John is presently working on a complimentary article relating track circuits to two-position signalling on the V.R. In a future issue it is hoped to reproduce two articles on V.R. automatic signalling that were originally published by an American magazine *Railway Signal Engineer* and written by Fraser Raynor-Wilson, a past signal engineer of the V.R.

A question has been received from Mr. Daryl Gregory of Wangaratta. "Assume that a distant signal and a home signal both mounted on the same post and BOTH operated from the SAME signal box, are mounted that way because of necessity, what colour would the distant arm be, and would the distant arm be mounted above the home signal or vice versa? Would the distant arm be necessarily be fixed permanently at caution? This is probably only a theoretical question as such a signal may not exist.

These signals do not exist as such in Victoria but they can be found in New South Wales and they may be fixed or operating. The distant arm is always the lower except where a co-acting arm may be provided for the home signal when this arm may be the bottom arm. The distant arm, in NSW, is always painted red even when by itself. The only signals in Victoria where home and distant arms are mounted on the same post, is where the block sections are short and the distant for the station in advance is mounted underneath the starting signal for the station in the rear or where a home signal for a level crossing is mounted above the distant signal for the next block station. These arms are painted red, mounted below the home signal arm and examples exist on the Coburg line (home signals at gates), and Castlemaine and Ballarat (short block sections). If any member has further information, please write to the editor.

ARCHIVES NEWS

Rob Weiss has offered to become the Melbourne representative of the S.R.S.V. Archives and so any donations of material to the archives may be sent to Rob at 34 Lake Road, Blackburn.

The societies' collection of signalling diagrams is slowly growing and thanks are due to Jack McLean and Bob Whitehead for the loan of certain diagrams for copying. These include the Sandringham line during mechanical days and the Geelong-Ballarat line during the singling between Bannockburn and Warrenheip.

During the sorting and indexing of the society's diagrams, a number of spare lithos and signal box diagrams have come to light and will be offered for sale to members. The list published on page 10 indicates the diagrams that are available (10c each, postage extra).

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SIGNALLING ALTERATIONS

9. 4.1978. LALOR. Signal lever 10 was provided on the control panel and will be brought into service at a later date.

9. 4.1978 CHELSEA. The interlocked gates were abolished and replaced by boom barriers. The mechanical signals have been replaced by three-position signals worked from a relay control panel on 19 December 1978 but the mechanical frame was retained to work the gates.

12. 4.1978 HAWTHORN. The switch locked goods siding was closed and the points spiked normal. The siding will be dismantled at a later date.

12. 4.1978 TOORADIN was closed as an electric staff crossing station. The home signals and No 2 road were removed and the plunger locks replaced by staff locks.

13. 4.1978 ARMADALE. The crossover and connection to the Toorak goods yard was spiked out of use. Until the home signals are converted to automatics, the signal controls from the signal box will remain in use.

WN 17/1978 YEA-CATHKIN-BONNIE DOON-MANSFIELD-ALEXANDRA. Except when trains are to cross, Guard in Charge of safeworking will apply. When trains operate on both lines on the same day, a competent employee will attend at Cathkin. A competent employee will attend to the hand gates at Yea for all trains.

WN 17/1978 RUTHERGLEN-WAHGUNYAH-MYRTLEFORD-BRIGHT. Except when trains are to cross, Guard in Charge of safeworking will apply. A competent employee will attend the hand gates at Rutherglen for all trains.

WN 17/1978 WAL WAL will be switched in as an electric staff station as required, train control to arrange.

18. 4.1978 MORNINGTON. Flashing lights were brought into use at Elizabeth St (62.4km) and Vale St (62.7km).

19. 4.1978 HARCOURT was closed as a double line block telegraph station. All signals and points were abolished.

20. 4.1978 MORNINGTON. Flashing lights were brought into use at Barkly St (63km) replacing the hand gates. Two up departure (light) signals were provided and are operated from push buttons on the platform.

WN 18/1978 TALLANGATTA-SHELLEY-CUDGEWA. Except when trains are to cross, Guard in Charge of safeworking will apply.

WN 18/1978 GARDENVALE. An emergency crossover has been provided to facilitate single line working during selected periods whilst the Nepean Highway overbridge is being reconstruction.

20. 4.1978 MACORNA. The home signals and plunger locks were abolished and staff locks provided on the main line points.

26. 4.1978 TOOLAMBA. The up and down distant signals on posts 1, 2 and 15 were fixed at caution.

26. 4.1978 NHILL. Lockbars 21 and 31 have been replaced by track circuits and plungers. A disc has been provided on post 5 for moves from No 1A road to Noske Mill siding.

2. 5.1978 BADDAGINNIE was closed as an electric staff crossing station. The signals, points and interlocking frame were placed out of use and will be removed shortly. Three signal posts were hastily removed, however, and taken to Glenorchy to replace the signal bridge which was damaged by a goods train derailment.

3. 5.1978 BEVERIDGE was closed as a double line block telegraph station. The signals and points were abolished.

4. 5.1978 HAWTHORN. The goods siding and points in the down line were removed and moves are afoot to redevelop the goods yard site.

7. 5.1978 EDITHVALE. Boom barriers were provided at Edithvale Road replacing the interlocked gates. The mechanical frame was abolished and the existing control panel, provided 23 January 1977 with the automatic signalling, now also controls the boom barriers in addition to the up and down automatic signals protecting the crossing.

9. 5.1978 BEACONSFIELD. Flashing lights were provided at Kenilworth Road (46.1km). Automatic signal D1479 is now normally at stop and is controlled through Stopping and Express selection push buttons on the panel at Berwick. The respective button must be pushed before the down departure home signals Nos 26 or 28 can be cleared. The buttons are not operated when Berwick is switched out.

14. 5.1978 EDITHVALE. The control panel has been relocated within the station building.

17. 5.1978 NORTH CRESWICK. Flashing lights were brought into use at Williams Road (139.8km). The staff lock at the up end of the siding was replaced by an annett lock and a staff/annett lock exchanger was provided. Removal of the annett key will switch the flashing lights to manual operation.

18. 5.1978 GLENORCHY. After the destruction of the signal bridge at the up end by a goods train derailment, posts 8, 9 and 10 were re-erected as ground masts recovered from Baddaginnie. This takes Glenorchy back to before 6.2.1948 when the signal bridge was provided in connection with track alterations.

21. 5.1978 ELSTERNWICK. B318 was relocated 106 metres in the up direction.

WN 22/1978 ARMADALE. Dwarf signals V1, Y1 and V10 were removed.

WN 23/1978 KOONDROOK LINE. Staff tickets now not normally used.

24. 5.1978 LITCHFIELD. Flashing lights were provided at Borung Highway (309.3km). A down home (light) signal was provided.

25. 5.1978 MASSEY. Flashing lights were provided at Sunraysia Highway (317.7km). The down end staff lock was replaced by an annett lock and a staff/annett key exchanger.

26. 5.1978 PIANGIL. The points leading from No 2 to No 3 road were spiked to lie for No 3 road. No 2 road was abolished and the points leading to the Stock Siding were spiked out of use.

30. 5.1978 MILDURA. Provision of a control panel and replacement of the mechanical signals by two position light signals. The control panel was provided to fit in with the modern image of the new station building similar to the recent provision of light signals at Tottenham Yard.

7. 6.1978 TEDDYWADDY. Flashing lights were provided at Calder Highway (288.1km). The staff lock at the down end of the siding was replaced by an annett lock and a staff/annett key exchanger.

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LIST OF SIGNALLING DIAGRAMS AVAILABLE FOR SALE

DEER PARK	6'43	LETHBRIDGE	11'34	CLAYTON	16'22
INGLISTON	22'16	BANNOCKBURN	8'34	DROUIN	4'58
PARWAN	15'40	BIRREGURRA	5'47	MORWELL	7'50
GORDON	5'26	COLERAINE JCN	20'27	DALYSTON	18'13
BUNGAREE	11'26	SOMERTON	6'59	ANDERSON	28'13
WARRENHEIP	2'36	HEATHCOTE JCN	14'40	LANCEFIELD JCN	13'18
BURRUMBEET	8'17	EUROA	15'29	CRESWICK	7'47
DOBIE	18'18	BOWSER	18'27	CLUNES	11'39
LAL LAL	20'34	MORNINGTON JCN	23'12	DARLING	12'29
MEREDITH	13'34	HUNTINGDALE	6'54		

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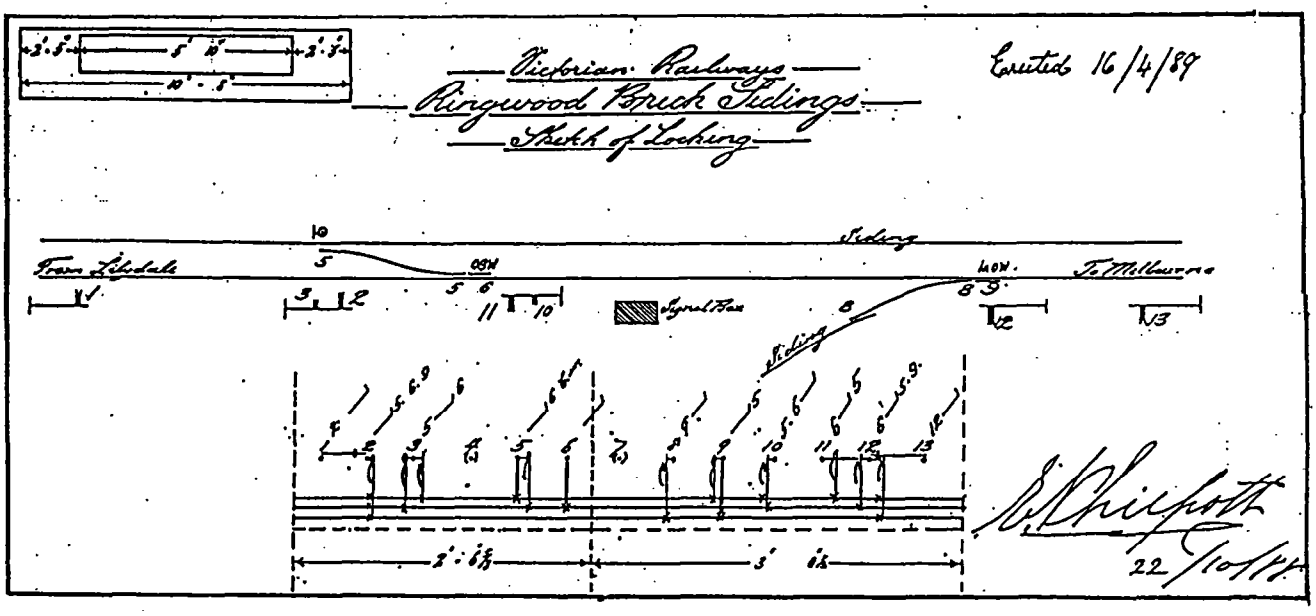
V.R. SIGNALLING HISTORY.
No 2. RINGWOOD BRICK SIDING
by Jack Mclean.

When the line was opened from Camberwell to Lilydale on 1 December 1882, there were stations at Ringwood and Warrandyte (renamed Croydon on 1 April 1884). The double line did not reach Ringwood until 21 December 1891 and the section to Croydon is still single.

On 15 September 1884, a siding (or sidings) were opened at 16¼ miles and two goods train were authorised to shunt there. These were the regular goods trains between Melbourne and Lilydale. The staff & ticket section then was Ringwood to Lilydale and Croydon did not become a staff station until 21 October 1886.

The Morse Telegraph, which was used to preserve the block between following trains, was superseded by Winter's Block, which was installed some time between 19 January 1887 and June 1887 according to the Working Timetables. They are so shown in the Appendix of 1888, but some doubt exists as to whether the Brick Sidings were a block post before being opened as a staff station.



Locking Sketch for Ringwood Brick Sidings.

The signal box was brought into use on 17 April 1889 and had a 13 lever interlocking frame with 11 working levers. There were four down signals, three up signals, two crossovers and two facing point locks. The sidings were opened as a staff & ticket station (and block post) on 12 August 1889. This is the same date that the Blackburn Brick Siding was opened as a staff station and the inwards and outwards tonnages at both locations suggests that there was a certain amount of clay transferred between the two locations.

The signal box was closed on 27 February 1892 and the location ceased to be a staff station on the same date.

It is obvious from the locking sketch that there were at least two sidings, one on each side of the line, indicating that there were at least two sources of bricks (and clay). From the Ringwood Historical Society I learn, however, that there were seven brick companies in the area, which accounts for the large tonnages shown in the Commissioner's Report and for the luxury of a 13 lever interlocking. The year 1892 seems to have been a year in which many similar commercial enterprises folded.

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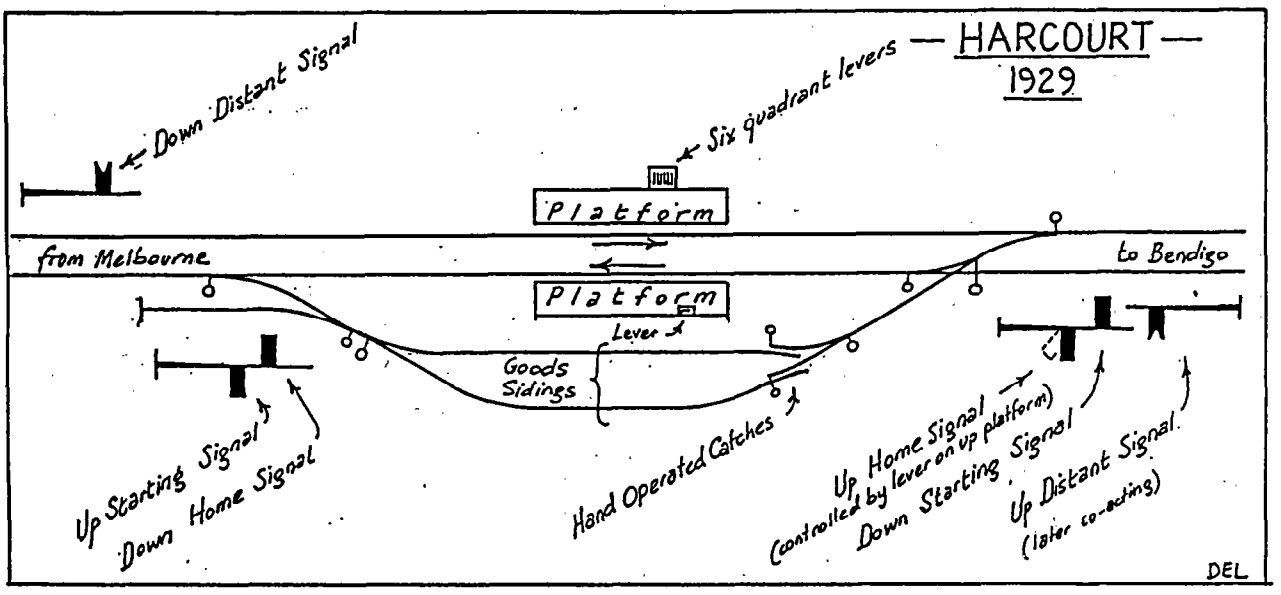
V.R. SIGNALLING HISTORY
No 3 HARCOURT
by Jack Mclean.

When the final section of 'The Main Line' from Kyneton to Sandhurst (renamed Bendigo on 1 September 1891) opened on 21 October 1862, Harcourt was among the stations provided. A photograph is reproduced in "VR to '62", p175, which shows the imposing station 'semaphore' and an up train in the platform in 1865. The semaphore was used until 1899 when six signals were provided and they were worked from non-interlocked quadrant levers which were located on the platform next to the station building.



Harcourt in 1929.

Harcourt was a block post for up trains only by 1888, using Morse Telegraph instruments, and two years later was a block post in both directions, this time using Winter's Block instruments. A closing switch was provided about 1901 and thereafter, Harcourt was switched in on a daily basis except Sunday, and this was the arrangement until about 1972 when it was switching in on Tuesday and Thursdays only for the running of the Woodend to Bendigo roadside goods, the slow nature of this train may have required it to be side tracked during shunting for a faster train. The roadside became 'as required' after 1974.

Weekly Notice No 17 of 1970 records the fact that the down end crossover and connections to the goods yard were abolished and this was the situation until 19 April 1978 when Harcourt ceased to be a block post. All that remains now is an unattended pair of passenger platforms guarded by an empty but imposing station building.

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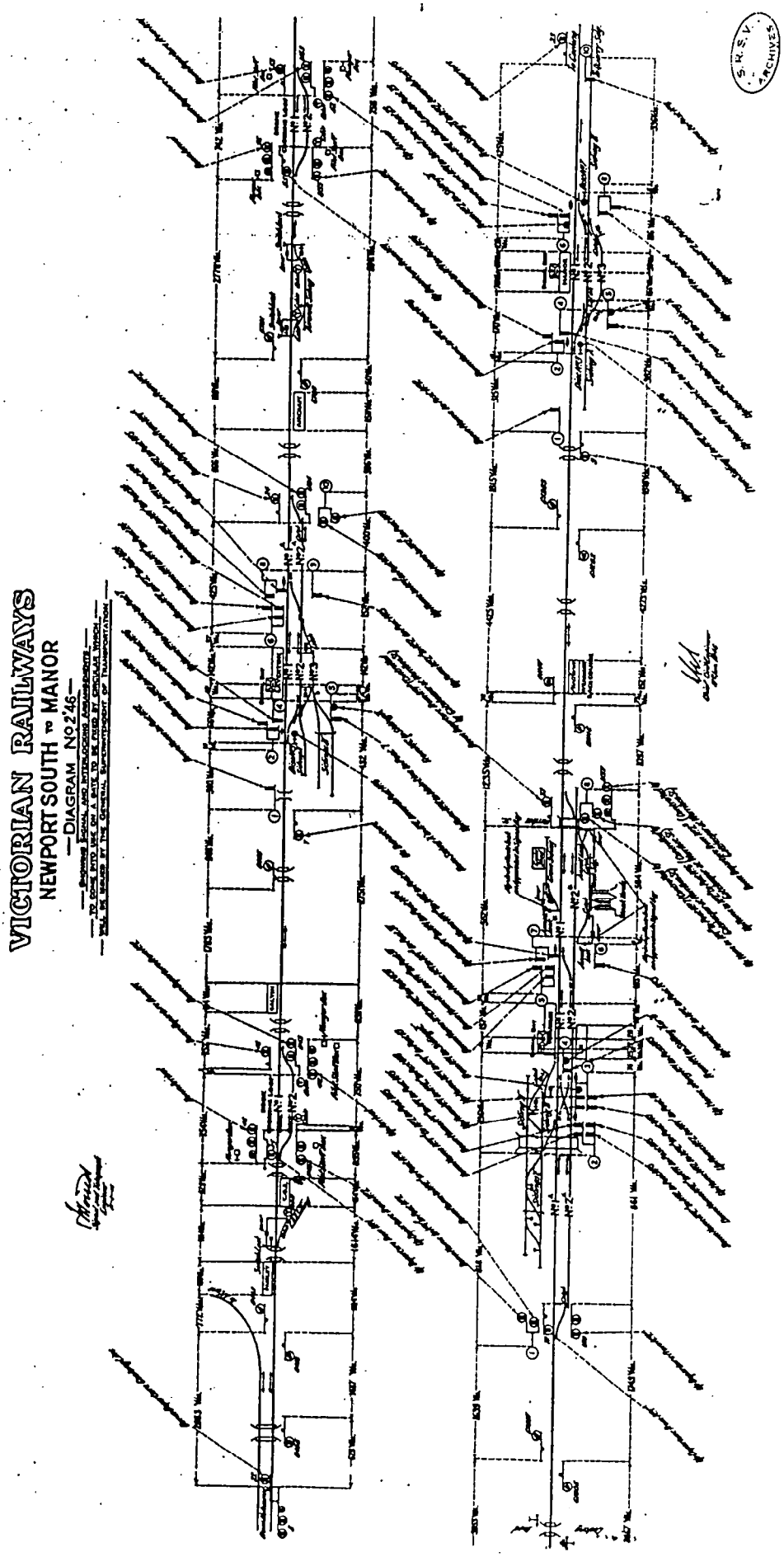

VICTORIAN RAILWAYS
NEWPORT SOUTH to MANOR
—DIAGRAM No 246—
S.R.S.V. ARCHIVES

TRACK CIRCUIT CONTROL
(Victorian Railways Practice)

by John Sinnatt.

1.1 INTRODUCTION.

The track circuit detects the presence of a train in a section. It may be used to control, for example, a signal, or an electric point lever lock, or a level crossing warning device.

In the typical track circuit, the section is first marked off by insulated rail joints and conducting bonds are provided around intermediate fish plates. A battery or other source of electrical energy is then connected to the rails at one end and a relay known as the Track Relay (TR) to the other. (Figure 1.1a).

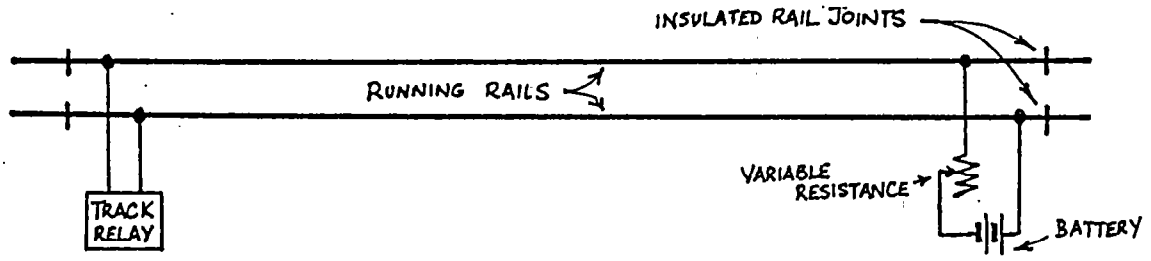


Figure 1.1a

When the track is clear, current flows through the relay coils; the armature picks up and makes a set of contacts (known as the top or front contacts). When the track is occupied most of the current flows instead through the wheels and axles of the train; the relay armature drops away and breaks the front contacts, making any bottom or back contacts that have been provided. A variable resistance in the feed to the track enables the circuit to be adjusted (or balanced) for best operation; it also prevents the battery from being directly short-citcuited.

When the section containing points is track circuited, changeover insulated joints are provided in the diverging lead so that two rails crossing at the 'vee' (or frog) will be of the same polarity (Figure 1.1b). At a diamond or flat crossing, two sets of insulated joints are required in the less important track.

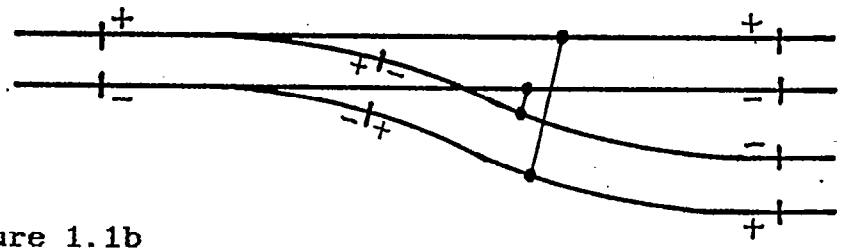


Figure 1.1b

Devices controlled by track circuit such as signal motors, point lever locks and boom barrier mechanisms require current to operate them from their most restrictive positions. Thus a signal motor when energised moves the arm to Proceed rather than puts it to Stop as in model railway practice. Similarly, a point lever lock requires energy to release the lever rather than to lock it

and a boom barrier mechanism requires energy to raise the booms rather than lower them. The current is fed through contacts made by the track relay when up (energised); where necessary a controlling relay is interposed.

When a train enters the section, the track relay drops and breaks the circuit to the controlled device. The signal then goes to Stop, or the point lever becomes locked or the booms drop. If the track battery becomes exhausted, or a rail breaks, or the coil becomes open circuited, the track relay also drops and puts the signal to Stop, etc. Similarly, if the power supply to the signal fails, the signal arm falls to Stop even if the track circuit is in perfect order. The whole system is an example of "fail safe" operation. This is a fundamental principle observed in railway signalling circuit design.

For many years track circuits used on the Victorian Railways were fed with either steady direct current, as assumed in Figure 1.1a, or with alternating current (25 Hz later changed to 50 Hz). In 1961/62, two other types new to the state were installed on the Somerton to Wodonga section of the newly constructed standard gauge line. These were the Coded (interupted) d.c. track circuit for controlling signals between crossing loops, and the Audio Frequency Overlay (AFO) track circuit superimposed on the Coded track circuits for controlling flashing lights at level crossings. These use frequencies between 1025 Hz and 2900 Hz. During the 1960's, the Westrak circuit was also introduced for controlling flashing lights on country lines not otherwise track circuited.

In 1976, two further new types of track circuits were introduced; the High Voltage Impulse, installed so far on point and yard tracks at relay interlockings, and the "Jointless" type installed (but not at points) on the Mordialloc-Frankston and Sunshine-Rockbank lines. It is understood to be proposed also for the Melbourne Underground Rail Loop, including the viaduct tracks. The "Jointless" circuit uses audio frequencies in the range 1700-2600 Hz.

In describing these various track circuits in greater detail it will be convenient to consider the track feed and relay connections were two adjacent circuits adjoin rather than in one complete circuit as in Figure 1.1a.

1.2 TYPES OF TRACK CIRCUIT

1.2.1 Direct Current

The d.c. for the track feed is obtained usually from a two volt secondary cell (Figure 1.2.1). The cell is floated across a rectifier powered from 110 volts a.c. This is a standard signalling voltage and may be obtained by stepping down from railway distribution mains or from a local SEC supply. If the a.c. fails, the battery carries the load for some hours.

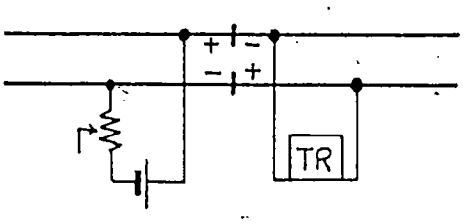


Figure 1.2.1

Earlier practice was to use 0.6 volt primary cells, with 0.6 or 1.2 volts fed to the track depending on the length. Some such track circuits are still in service.

Adjacent track circuits are usually of opposite polarity. This reduces the possibility of a relay being wrongly energised by the adjacent battery if the insulated joints should break down.

The length over which a track circuit may be worked reliably is limited by leakage through the ballast. The maximum length of the simple d.c. circuit described is understood to be around 1300 yard (about 1200 metres) but may be increased to around 3500 yards (about 3200 metres) by coding the feed.

Direct current track circuits are not suitable for use on d.c. electrified lines owing to the presence of traction current in the rails. Their use in Victoria is thus restricted to country areas.

1.2.2 Alternating Current

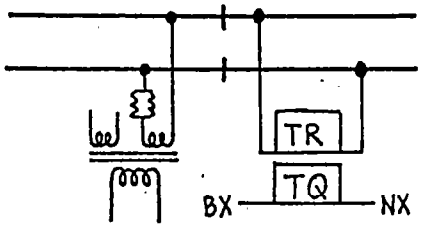


Figure 1.2.2a

The a.c. for the track feed is obtained from a 110v/6v transformer (Figure 1.2.2a). The relay is of the double element vane type. One element or coil, TR, is connected to the track while the other, known as the local coil, TQ, is connected directly to 110v a.c. In railway signalling diagrams, the BX/NX refers to the 110 volts supply. Other supplies are designated by their particular voltage and polarity thus B6, N12, etc.

The a.c. in the local coil TQ induces eddy currents in the armature, a slotted aluminium vane. If the track or control coil TR is also energised with a.c., the vane becomes a current carrying conductor in a magnetic field; it moves amd makes contacts. For best effect, the currents in the two coils should be 90 degrees out of phase. The relay will not operate on direct current.

Alternating current track circuits are used on d.c. electrified lines, on some goods lines in the Melbourne area and on the Geelong line. On electrified lines, impedence bonds are installed at insulated joints with their centre points connected as in Figure 1.2.2b to allow traction current to return to the substation. At points and crossings, and on some other short tracks,

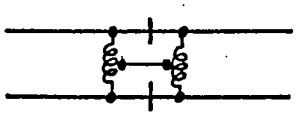


Figure 1.2.2b

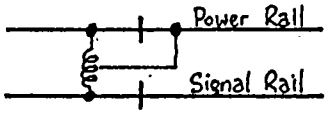


Figure 1.2.2c

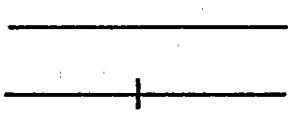


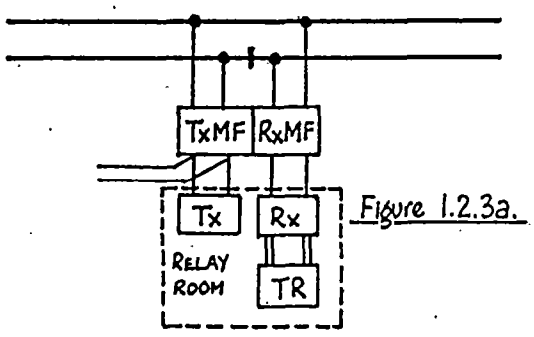
Figure 1.2.2d

one rail is nominated for signalling and one for traction; the connection to such a 'single rail' track circuit (on the right) is shown in Figure 1.2.2c. Where two 'single rail' track circuits adjoin, only the signalling rail is insulated as in Figure 1.2.2d and no impedance bond is required.

1.2.3 High Voltage Impulse

The equipment to be described originated from the Jeumont-Schneider Company in France. It is used for single rail point and yard track circuits.

High voltage impulses are generated at the rate of three per second in a Transmitter (Tx) by periodic discharge of a capacitor through a network. The waveform and other details are shown in Figure 1.2.3b.



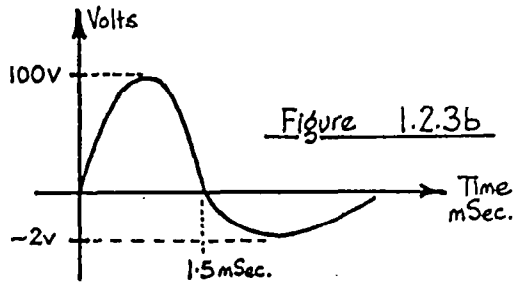


Figure 1.2.3a **Figure 1.2.3b**

The Tx is located in the relay room, as shown in Figure 1.2.3a. The impulses are fed to the track through a Transmitter Matching Transformer (TxMF). Up to four tracks may be fed from the one transmitter, each through its own TxMF, but the peak voltage is reduced from 100 volts down to 50 volts positive and from 20 volts down to 10 volts negative.

The other end of the track circuit is connected through the Receiver Matching Transformer Unit (RxMF) to the Receiver (Rx) also located in the relay room. The Rx is not an electronic device but consists of a specially designed transformer with two secondary windings each connected through a diode to a corresponding winding on the special Track Relay (TR). One path passes the positive portion of the impulse and the other the negative portion. The design is intended to ensure that the TR will respond only to impulses of similar shape to those transmitted.

The TxMF and RxMF units are housed in small galvanised metal boxes mounted horizontally beside the track. Two units fit into the one box. A 2000uF capacitor is included in the track feed. These boxes are a characteristic external feature of the High Voltage Impulse track circuit installations. They may be seen at Spencer Street No 2 Box, Flinders Street D and E Boxes, and at Chelsea, Carrum and Seaford on the Frankston line.

Various advantages have been claimed for the use of the Jeumont-Sneider HVI track circuit:-

* - It gives reliable operation with rusty or dirty track. It is thus particularly suitable for use at a route setting relay interlocking where momentary moss of shunt might allow a TR to pick up and release a route. (At Camberwell, with conventional a.c. track circuits, a time delay of four seconds was imposed before points could be altered after a TR picked up.)

* - It is immune to false operation from currents generated in the track by the chopping action of thyristors where these are used to control electric locomotives. Interference from this cause has proved troublesome in some overseas countries.

* - It is suitable where the ballast resistance is unusually low. Thus it is used on the Kooragang branch in NSW which serves

an island reclaimed from the Hunter River.

* - It allows all active equipment to be concentrated in the relay room with attendant maintenance advantages.

1.2.4 Audio Frequency "Jointless".

The equipment used in Victoria is known as CSEE type UM71. An audio frequency generated by a solid state Transmitter (Tx) is fed to the track at three to five volts through a Matching Unit (MU) and a Tuning Unit (TTU). The other end of the track is connected to a Receiver (Rx) through a Tuning Unit (RTU) and a Matching Unit (MU). The Rx responds only to the frequency sent by the Tx and delivers an output to operate a conventional d.c. relay (TR). Both the Tx and Rx require a regulated 24 volt d.c. supply.

Different frequencies are used for adjacent track circuits. Along with suitable design of the interface, this provision enables insulated joints and impedence bonds to be dispensed with and facilitates welding of rails into long sections.

Frequencies of 1700 and 2300 Hz are used for alternate track circuits on one track, and 2000 and 2600 Hz on the other. In particular, 1700/2300 Hz is used on the down line between Mordialloc and Frankston, and on the North line between Sunshine and Deer Park West Junction together with the single line to Rockbank.

An Air Core Inductor (ACI) is connected across the rails at the theoretical 'joint'. The impedence of the ACI at the frequencies used is about 0.25 ohms. (According to some references, it should be sufficient to provide a direct short circuit at the 'joint'. But a short wheel base vehicle or a metallic obstruction across the track at that point, might not then be detected.) A centre tapping on the ACI allows for connection of cross bonds to the opposite track for equalising of traction return currents.

The two Tuning Units are connected to the track at a measured distance each side of the ACI. Each unit consists of a coil and capacitor designed to resonate at the frequency used; the inductance of the rails between the point of connection and the ACI forms part of the resonant circuit. The 'joint' is not actually sharp; the two track circuits overlap for about two metres in the vicinity of the ACI.

The Matching Units consist of a transformer with d.c. blocking capacitors on the track side and multiple tappings on the Tx and Rx side. The same design is used for all frequencies and for both Tx and Rx, but chokes are strapped into circuit in a TxMU and correspond to the feed resistance in a conventional track circuit. The transformer tappings are varied according to the distance of the Tx and Rx from the 'joint'.

The TUs, MUs and ACI are housed in small fibreglass boxes mounted beside the track. Two MUs are contained in the one box. The boxes are disposed physically as shown in the block diagram Figure 1.2.4.

At an intermediate signal or level crossing location, the Tx and Rx will be housed in the adjacent relay box. Near an interlocking area, they may be housed in the relay room which, particularly in the Sunshine-Rockbank section, may be up to 1 km away A remote location is feasible because the Rx actually supplies an output of 60 volts; this high output also allows connection to the MU by telephone cable with a conductor resistance of about 50 ohms per loop km. The tappings on the MU transformers are then adjusted so as to deliver the required low voltage to the track, and the required minimum voltage to trigger the Rx.

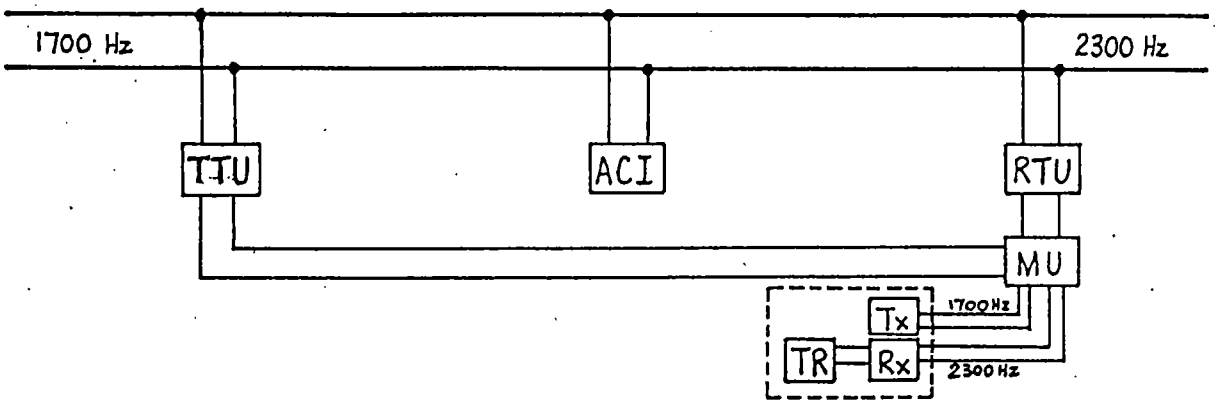


Figure 1.2.4

Where a CSEE track circuit adjoins another type, which in practice is usually a single-rail a.c. or Jeumont circuit, insulated joints are required, together with an impedence bond as in Figure 1.2.2cm, if the line is electrified. At these locations, the ACI and TU are mounted back-to-back and share a common connection to the rails; the MU is mounted close by at right angles.

A group of three fibreglass boxes may also be seen near the mid-point of some of the longer signal sections. A Tx may be connected to the track at these points to feed the same frequency in both directions to a relay at each end. A group of five boxes is provided at signal F 1088 near Bonbeach. Here, most unusually, insulated joints are used to separate two CSEE track circuits.

A triangular shaped case may be seen mounted inside the track at some stations on the Frankston line. The case contains a Pin Point Detector (Figure 1.2.4b), which is inductively coupled

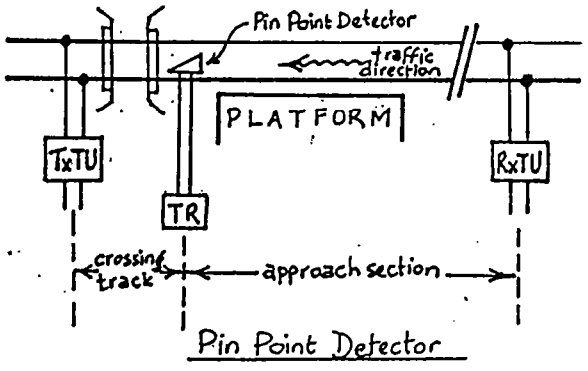


Figure 1.2.4b

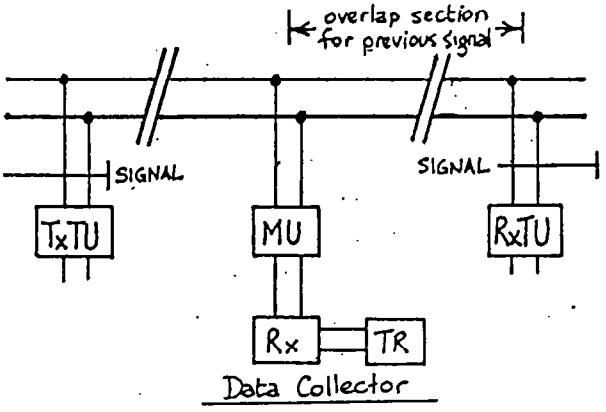


Figure 1.2.4c

to one rail. The PPD is connected through an MU to an Rx and a TR. The TR operates when the section is clear between the Tx and the PPD. It is additional to the TR which operates when the whole section is clear. The PPD is usually provided on the platform side of a level crossing equipped with, or about to be equipped with, boom barriers, in a position where there would be no room for a normal spread out CSEE joint. The Tx is located on the other side of the crossing. PPDs are installed on one or both tracks at all stations - Aspendale to Carrum.

Another method of coupling at an intermediate TR location is simply to connect the RxMU direct to the track, but with additional resistance inserted to reduce the bridging loss. The

cutoff in this case is not at all sharply defined and the TR is known as a Data Collector (Figure 1.2.4c). A Data Collector would not be used at a signal or crossing but might be suitably located at the beginning of a level crossing approach track.

Railway power is distributed on the Mordialloc to Frankston, and Sunshine to Rockbank sections at 650 volts a.c. instead of the traditional 2,200 volts on suburban lines. The 650 volts is stepped down to 110 volts; this is used to supply the rectifiers feeding 24 volts d.c. to the Tx and Rx. Batteries are not used.

1.2.5 Coded Direct Current Track Circuits

The d.c. track circuits installed on the standard gauge line beyond Somerton Loop are coded (i.e. the track feed is interupted at a regular rate) except through crossing loops (and some station yards-Ed). Coding enables reliable operation to be obtained over longer lengths (up to around two miles on the SG line) than with steady energy track circuits. Information can also be conveyed by using different coding rates.

At the sending end, a two volt battery feed (B2, N2) in Figure 1.2.5a is interupted 180 times per minute by a contact operated by the Code Transmitter 180CT. This is an oscillating relay, not an electronic device. As explained below, another relay contact may be included at 'X'.

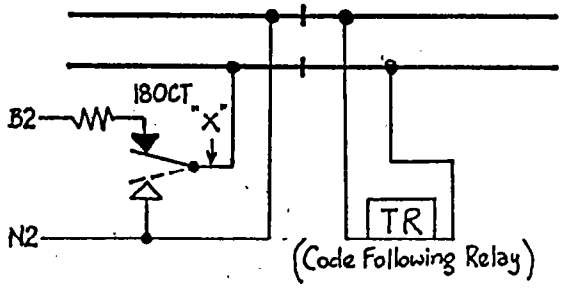


Figure 1.2.5a

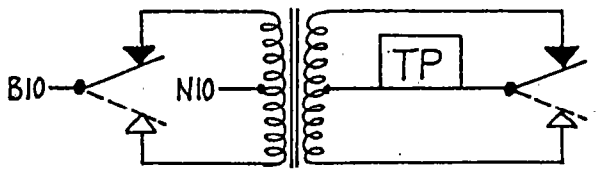


Figure 1.2.5b

At the other end, the track relay follows the code received. One contact supplies 10 volts positive battery alternatively to the outer ends of the primary winding of a transformer, the negative side is connected to an intermediate tapping. A second contact of the TR connected a Track Repeat Relay (TP) alternatively to the outer ends of the secondary winding, Figure 1.2.5b. The two TR contacts move in synchronism so that the flux in the primary is, in effect, rectified. Provided therefore that the track is clear and code is present. steady direct current will flow through the TP and this relay will be operated.

Contacts on the TP relay may be included in signal circuits as required. A contact may also be included in the feed to the adjacent track section at point 'X'. Where a track circuit is controlled by the next track circuit in this way, it may be referred to as a Cut Section track circuit. It is then designated ..CT rather than ..T and a curved arrow indicates the control direction. On the SG line, cut sections are used in conjunction with a change of code to 120 in the last track section to give an approach indication at a crossing loop.

In Figure 1.2.5c, code following track relay 10TR through its steady repeat 10TP, controls signal D9 and also the feed to B6CT by a contact inserted at point 'X' in Figure 1.2.5a. Relay

B6CTR in turn controls the feed to A6CT. There is no signal here and the track is cut only because of the limitation on length.

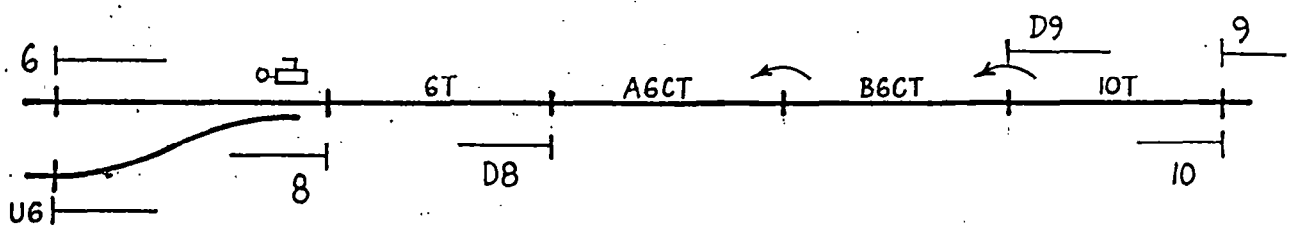


Figure 1.2.5c

Decoding is not required and a vibrating B6CTR contact is included directly in the feed in place of the 180CT contact. Thus A6CTR picks up only if A6CT, B6CT and 10T are all clear.

Relay A6CTR cannot control the feed to 6T in the same way because an approaching train would then drop 6TR and put signal D8 to Stop. Instead A6CTP, when up, applies code 180 to 6T, but when down applies 120 code. If code 180 is received at the loop, it means that the section from signals 9/10 is clear and that, for example, it would be safe for the Train Controller to put back signal 8 and change the points.

The decoding transformer circuit in Figure 1.2.5b works equally well on either code. To detect that 180 is specifically present, leads are taken from the outer ends of the primary of the decoding transformer to a selective decoding until as shown in Figure 1.2.5d. This consists of another transformer with a capacitor in series with the primary winding, with the unit being designed to resonate at code 180. The secondary is connected through a full-wave rectifier to a d.c. relay AR (Approach Relay); thus AR is operated while the section is clear back to signals 9/10.

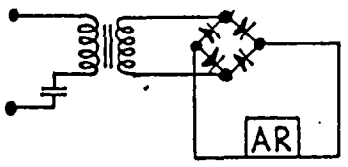


Figure 1.2.5d

On the SG line, railway power is distributed at 440 volts a.c. on aerial lines. This is stepped down to 110 volts to supply rectifiers delivering two volts and ten volts d.c. Batteries are floated across the rectifiers and are used to supply voltage during an interuption to the 440 volt supply.

1.2.6 Other Track Circuits.

The track circuits already described are those commonly used in interlocking areas or for controlling automatic signals. Other track circuits are available for more specialised applications. These include:-

* WESTRAK - an a.c. circuit which allows the TR to be at the same end as the feed. A static rectifier unit is connected across the rails at the other end. Specially applicable for controlling flashing lights on country lines. Avoids linking the approach track sections to the relay box by cable or aerial wires. Many installations in recent years.

* AUDIO-FREQUENCY OVERLAY (AFO) - superimposed on coded track circuits for controlling flashing lights on the SG line.

Avoids insulated joints at beginning of approach track and at the crossing but is somewhat different from the 'jointless' track circuit (CSEE) already described.

* ELECTRIC SWITCH LOCK RELEASE - when the TR of the short releasing track section drops, the circuit to lift the lock is completed through the wheels and axles of the train. This avoids the possibility of an unsafe release due to failure of the TR.

* APPROACH TRACKS AT UNATTENDED STAFF STATIONS - Special track circuits have also been used at Unattended Electric Staff stations provided with automatic arrival signals. These economise in current consumption and obviate the need to run line wires through the station.

All these track circuits mentioned will be explained in further detail at the appropriate stage later in these notes.

The author wishes to thank Colin Rutledge for supplying certain technical information.

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