

MELBOURNE AND METROPOLITAN TRAMWAYS BOARD.

WORKSHOPS AND RUNNINGSHEDS BRANCH.

RUNNINGSHEDS SECTION.

ELECTRICAL FAULTS ON TRAMCARS.

The following procedure for Electrical Faults on Tramcars was compiled by Senior Foreman R. J. Tippett.

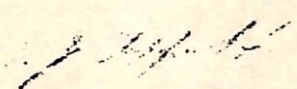
The best form of trouble shooting is preventive maintenance of the equipment so that troubles will not develop, for example, careful attention to keeping all parts clean, especially where dirt may collect causing creepage and flashovers. Most electrical troubles are "mechanical" and equipment in good mechanical condition is not liable to give trouble.

Be reasonably certain that there is actually trouble, because the only trouble which cannot be located is the one that does'nt exist.

Consider all outside reports, but draw your own conclusions. Look for the simpler things first, - blown fuse, tram isolated on dirty rails, etc.

Never jump to conclusions even though the same conditions might have been encountered before.

Use eyes, ears, and nose diligently to save time for often the trouble might be found immediately.

  
R. J. Tippett.

RUNNINGSHEDS SECTION.

ELECTRICAL FAULTS ON TRAMCARS.

If a defective tram has been temporarily repaired by traffic personnel and is proceeding safely under its own power, allow the tram to proceed to the nearest depot or if it is at a terminus an inspection can be made and repairs or adjustments made to allow tram to be returned to traffic or C/O at the nearest depot.

In peak conditions if the tram is still defective do not hold up the tram to rectify the fault but push the tram and attempt to rectify the fault whilst being pushed.

Question tram driver about the defect and what he has done to try to rectify the fault, then draw your own conclusions.

SAFETY PRECAUTIONS:

At all times before removing the controller cover to inspect or make any adjustment or repairs the L/breaker switch must be placed in the "OFF" position, and the reverse key that belongs to the defective car be used on the appropriate controller and the controller rotated through all notches to make sure that the controller is electrically dead.

DEFECT.	CAUSE.	RECOMMENDED PROCEDURE.
K35 or DK controller. Blistered fingers & segments.	Incorrect adjustment: Bad driving.	Remove blisters by filing, oil segments & adjust if necessary.
K35 or DK cont. Bent finger.	Incorrect adj. Bad driving.	When at a terminus, replace bent finger, re-align with the segment & adjust finger lift. If the tram is holding up traffic, and if no tools are available, lift the bent finger on to the segment, straighten finger by using the gong punch as a punch & the back of the brake valve handle as a hammer, after the finger has been straightened, re-adjust lift. This is only a temporary repair and finger must be replaced at a terminus or depot as soon as possible.
K35 or DK cont. Arcing & burning contacts.	Bad adjustment or alignment. Bkn.finger spring.	File & oil controller fingers & segments & adjust to correct lift, re-align finger to the segment. If the finger & segment is badly burnt, arrange C/O at the nearest depot.
All types of contrs. Locked contr. Main barrel. Locked with the reverse key in the forward or reverse position.	Bkn.reverse barrel locking spring.	Remove controller cover, place reverse key in the forward position & move the locking lever by using hand into correct position with reverse barrel star wheel. This operation will have to be repeated every time the reverse key is moved. Tram must be C/O at the nearest depot. <u>Note:</u> The only controllers on which the reverse spring can be replaced on the road is the K35 or K36 contrs., & this should only be done at a terminus.

ELECTRICAL FAULTS ON TRAMCARS.

EFFECT.	CAUSE.	RECOMMENDED PROCEDURE.
K35 controller. Unable to remove reverse key.	Reverse barrel locking lever fouling gap in main barrel star wheel.	Place linebreaker switch in "OFF" position, place controller handle full on position & bring it smartly to the "OFF" position hitting the stop hard; if it fails to clear fouling, repeat 2 or 3 times, if this fails try the same procedure but hitting the full on stop, if this also fails, loosen main handle from the barrel taper this will clear the fault, C/O tram at the nearest depot. This fault will only occur at a terminus or shunting back at a crossover, if at a crossover & there has been a big delay, remove tram from service & drive in its original direction, to the nearest terminus where fault can be cleared.
Clyde contr. Main barrel jammed either cutting on or off.	Main star wheel locking set screws loose & fouling locking arm.	Tighten set screws and tighten locking screws and C/O at the nearest depot.
K35 or K36 controller.	Tip off finger or No.4 segment off barrel & jammed in the troughing.	Remove the obstruction and replace finger tip or segment using new material.
K35 controller unable to cut 1st notch.	Ratchet switch pawl arm retaining screw loose & fouling bottom of arc shield frame.	Tighten screw and check that ratchet switch pawl has free movement.
All types of controllers unable or very hard to cut the 1st notch.	Ratchet or tripping switch fingers & segments dry or too much lift.	If dry, lubricate, if fingers have too much lift re-adjust to correct lift.
K35, 36 or DK controllers intermittent power 1st notch.	Loose ratchet switch grub screw. Light finger contact. Worn ratchet switch pawl.	Tighten grub screw & notify D/F for further attention. Re-adjust finger to correct lift & if necessary file contacts. If at a terminus, C/O the pawls; if on the road, bridge ratchet switch fingers, arrange to C/O tram at nearest depot.
	Light contact 1st earth finger - (B) finger.	Re-adjust to correct lift. If in peaks or busy traffic bridge finger to controller frame & re-adjust at a terminus or arrange to C/O tram at nearest depot.
All types of controllers - No power Control circuit.		Turn on lights, if O.K. take reverse key & brake valve handle to the other end, if power is obtainable investigate other controller by the following means, after first changing the L/breaker fuse with a tested fuse.

EFFECT.	CAUSE.	RECOMMENDED PROCEDURE.
Broken ratchet switch spring.		Replace spring (always remember that one is always available from the other end controller).
Broken ratchet switch finger.		Bridge ratchet switch fingers & arrange to C/O tram at the nearest depot.
Ratchet switch pawls worn & switch not operating.		Bridge ratchet switch fingers and arrange C/O the tram at the nearest depot.
1st earth finger (B finger) not making contact.		If in peaks or busy traffic, bridge finger to controller frame; if at a terminus re-adjust finger to correct contact or arrange to C/O the tram at the nearest depot.
K35, DK & Clyde controllers. No power Blowing L/breaker fuse.	Carbon track on ratchet switch fingers or contact insulation blocks.	Try to clear carbon track by wiping. Replace blown fuse with a tested fuse; if fuse still blows, insert bridging stick in L/breaker as per code.
K35, DK or Clyde Controllers. No power Control circuit.	Linebreaker coil deft. Main contact tip fallen off, broken pressure spring, burnt out resistance tube or broken or earthed control wiring.	Insert bridging stick in linebreaker as per code.
K35, DK, Clyde controllers. No power on 1st notch but will start on a later notch up to full series position.	Controller finger not making contact. Bkn. or burnt out resistance grids or bkn. bridge wire between resistance boxes.	If controller finger is at fault re-adjust, but if defect is common to both ends (both controllers must not be operated beyond full series position). In peak conditions do not attempt to bridge broken grids but drive the tram it may be necessary if the tram is heavily loaded to get pushed to start. If on starting on a steep grade, cut out the leading pair of motors which will allow the trailing wheels to spin, after the tram is moving apply sand to the track, when on level track return the motors to the normal posit.
K35, DK & Clyde controllers. Blowing L/B. on 1st notch.	Foreign metallic body on or touching the resistances & shorting to the rail.	Remove foreign body & check for damage to resistances; if it is a piece of broken check rail fouling the resistances, bend clear & after tram has been driven clear, cut or break the projecting piece of check rail & inform Civil Branch via Radio Centre for further attention.
Broken interlock finger or stop plate welded to L/breaker post & to interlock earth contact.		Place trolley pole under the hook & attach temporary lights to both ends of tram if reqd, then disconnect L/B earth wire from the main earth wire by disconnecting or cutting, replace trolley pole on O/head wire, then cut a notch of power, if L/Breaker does not blow insert bridging stick in L/B.,

DEFECT.	CAUSE.	RECOMMENDED PROCEDURE.
K35 controller Blowing L/B, E.M.B.rheostat insulation bkn.down between R4 & R5.	Flood damage.	as per code & C/O the tram at the nearest depot.  Try cutting out Nos. 1 & 3 motors & if tram drives full power on two motors will be obtained on the 1st notch cut as quickly as possible to full series running notch, if un- successful push or tow tram to the nearest depot or terminus, if at a terminus disconnect all wires from the rheostat box tying them clear of all metal; if any of the motors have been cut out return them to normal, power will not be obtained until reading the full series running notch but must not be operated beyond that point, for driving tram up a steep grade it may be necessary to cut out the pair of leading motors & return- ing them to normal after the grade has been negotiated.
K35 contr. blowing L/B.	Motor cut out switches half cocked.	Return switches to normal.
Controllers all types blowing L/B after changing ends.	Reverse barrel half cocked & reverse fingers making con- tact with segments.	Take reverse key to other end of tram and check to see that the reverse barrel is in neutral, warn driver to take special care when changing ends and change over tram at the nearest depot.
No power Rail- way Trams Nos. 52 & 53.	Blown main fuse located on the roof along side No.2 trolley base.	Place the trolley pole under the hook & if necessary attach temporary lights to both ends of the tram, open the fuse box, undo the clamp screws at both ends & renew fuse. A spare fuse comprising of three strands of .052 tinned copper wire attached to the trolley wire near the fuse box.
K35 controller Flashover in controller.	Bad driving, especially over O/head sections cut offs. Bad adjustment of controller fingers Carbon track or broken main barrel insulators.	Clean up controller fingers and segments and wipe arc chute & barrel insulators & re-adjust fingers if required and change over the tram at the nearest depot.
Dk controller Flashover in controller.	Bad driving, especially over O/H cut offs, broken grid on rheostats, bkn. finger spring or bad adjustment of fingers.	Clean up controller fingers and segments and wipe arc chute and insulation of barrel and if finger defective, replace and re-adjust fingers if required. Controller not to be operated beyond full series running position.
Clyde controller. Finger contact tip off.	Failure of spring washer.	Replace contact tip not forgetting to renew spring washer.

DEFECT.	CAUSE.	RECOMMENDED PROCEDURE.
Welded finger.	Bad adjustment broken finger shunt.	Replace the finger and re-adjust for correct contact.
Arcing that could lead to a flash- over.	Bad adjustment especially of the two trolley fingers on the 6th notch.	File contact faces and re-adjust. The 2nd trolley finger must make before the 1st trolley finger breaks contact.
Slow tram.	Pair of motors cut out.	Instruct all Runningsheds personnel to take more care to prevent a recurrence. Sometimes it is caused by tram drivers instructing students the method of cutting out of motors.
Defective motors or motor leads.		Trap doors or motor inspection lids not to be lifted at any time while the tram is in service but cut out the appropriate motors according to the procedure laid down in the instructions to drivers in electric tram operating and change over tram at the nearest depot.

R. J. Tippet.

Senior Foreman.

Runningsheds Section.

Remote Control Equipment:

Push tram if possible, don't wait until fault is rectified in any peak conditions.

Question tram driver as to defect, and what he has done to rectify same, then draw your own conclusions.

SAFETY PRECAUTIONS:

At all times before removing the controller cover to inspect or make any adjustment or repairs, the reverse key must be in the possession of the Charge Hands. Place the linebreaker switch to the "off" position, and rotate the controller handle through all notches of power.

Arcing in Controller:

Place linebreaker switch in "off" position, open the controller and check fingers for light contact or misalignment with the segment.

If motors have been cut out and tram is immobile return them to the normal position.

Care must be taken to ensure that the Driver has not placed all the motors in the cut out position and if the tram is reported slow see that the separate earth blade is in the closed position.

No Power:

Renew the fuse and make certain that it is tight in the clips then attempt to drive tram by operating the controller by cutting each notch slowly to the 1st parallel notch. If tram moves, instruct driver to proceed and arrange to have tram changed over at the nearest depot. If power is obtained on the 1st parallel notch and the linebreaker opens due to overload, place linebreaker switch to the "off" position open the controller and list LSl finger off contact with the segment, close controller replace linebreaker switch to "on" position and a two motor feed will be obtained in the parallel notches. Arrange to changeover tram at the nearest depot (probable fault a defective LSl or JR unit, or interlock).

No power any notch on the Controller:

Renew the fuse in linebreaker switch, then cut each notch slowly, if the fuse blows, don't cut off the controller, but place the linebreaker switch to the "off" position, remove controller cover, and observe which controller finger was last to make contact, lift it clear of segment, place controller in the "off" position, change blown fuse in linebreaker switch, drive tram if O.K. Arrange to have tram changed over at the nearest depot (probable fault, a burnt out unit coil). If at a terminus open main knife switch then carry out the above procedure, after fault has been cleared replace knife switch to normal.

NOTE: If the fuse blows on the first notch - Lift LSl finger off contact with the controller drum and power will not be obtained until parallel notches are cut.

If after carrying out the above procedure, the linebreaker blows on the 1st notch -

Place linebreaker switch to the "off" position remove controller cover examine tripping switch finger block and the contact insulation piece for carbon tracking, attempt to clear carbon track, change linebreaker fuse, and attempt to drive tram. If O.K. arrange to change over at the nearest depot. If the fuse still blows, off load passengers and push with the following tram.

No Power Tripping Switch Defects:

Broken tripping switch finger, contact mounting insulation piece, stop plate, ball race, or wire loose or broken at wiring lug. Quickest method is to bridge contact fingers on mounting block if not possible drive tram from rear end.

Tripping Switch Dropping out of 1st Notch:

If the contacts and fingers are dry, lubricate, re-adjust finger, if they have too much lift. If tripping switch arm is fractured or compression spring defective, the quickest method is to bridge contact fingers on the mounting block, if not possible, drive from rear end.

Losing Power 2nd or 3rd Notch on the Controller:

Bridge 1st earth finger (B Finger) to controller frame, or insert bridging stick in linebreaker (fault linebreaker interlock finger light contact or broken, or open circuit resistance tube).

Holding Power until 1st Notch when Cutting off Controller:

Broken tripping switch pull off spring, replace spring. Test and if operating O.K. allow tram to remain in traffic, notify depot. Rivets broken in tripping arm, limit stop plate or worn tripping slots in star wheel, quickest method is to bridge tripping switch fingers on mounting block; if for some reason, not possible, drive from rear end.

Opening Linebreaker due to Overload 1st Notch:

Cut out 1 & 3 motors. If unsuccessful examine rheostats for foreign body shorting the grids or to the rail. If O.K. the fault could be broken linebreaker interlock finger or stop plate welded to the linebreaker post and to interlock earth contact. To clear fault remove pole from overhead wire and place under the hook. Disconnect linebreaker earth wire, from the main earth wire by disconnecting or cutting, replace trolley pole on overhead wire, cut a notch of power and if linebreaker does not blow insert bridging stick and change over at the nearest depot.

Opening Sub-station feeders, or Linebreaker as soon as pole is placed overhead:

Tie down both trolley poles, attach temporary lights to both ends of tram if required, and push or tow tram to nearest depot, when berthed in depot, remove both trolley ropes, open main knife switch and attach a "danger, don't move board" to the tram, then leave a complete report for Depot Foreman.

SAFETY RULES WHICH MUST BE OBEYED WHEN INSERTING BRIDGING STICK BETWEEN LINEBREAKER CONTACTS:

- (a) If necessary place temporary lights at both ends of tram.
- (b) Apply hand brake, and remove reverse key and air brake handle. Charge Hand is to keep them in his possession until job is completed.
- (c) Trolley pole is to be removed from overhead wire and placed under the hook and an employee stationed at back end of tram and must not allow pole to be replaced on overhead wire until instructed by Charge Hand.



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SAFETY RULES WHICH MUST BE OBEYED WHEN INSERTING BRIDGING STICK BETWEEN LINEBREAKER CONTACTS.

- (d) The employee inserting the bridging stick in the line-breaker must be guarded at all times by the Charge Hand or if working single handed by a Traffic Employee.
- (e) Charge Hand must personally see that all Employees are clear and then have the trolley pole replaced on overhead wire, air brake handle and reverse keys replaced. If possible use a Runningshed Employee as the Driver but ~~first~~ warn him to notch the controller carefully and ~~observe all~~ overhead cut off signs as the Line-breaker automatic overload is shorted out.
- (f) On no account is the controller to be opened while the linebreaker is bridged without first removing trolley pole from overhead wire.

NOTE:

Remote Control unit contact tips must not be bridged at any time, no exception is to be made.

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Melbourne & Metropolitan Tramways Board.

TRAM CAR BRAKING on GREASY RAILS.

The following comments are offered to Tram Drivers with a view to improving their braking methods when running on greasy rails.

Incorrect use of sand and increasing the air pressure during stops are the cause of skidding which results in "flats" and collisions.

It has been observed that sand is incorrectly used by many drivers who otherwise drive very well; some do not use sand at all, some use it too late and some use it needlessly.

There are many conditions which cause greasy rails, the most common being:-

1. When rain commences.
2. Frost or morning dew.
3. Track repairs or top dressing using bitumen compounds.
4. Oil, fallen leaves or melted tar in hot weather.
5. Motor vehicles running over rails drying out after rain (very greasy).
6. New rails, even when clean, can cause conditions like greasy rails. (Treat new rails as you would greasy rails).

(Contd.)

Where such conditions exist, lighter air pressure is required (to prevent skidding) therefore braking should commence at a much longer distance than normal. The pressure applied should be just sufficient to bring the tram to a standstill where desired without any need for an increase in the pressure.

Before the required air pressure is applied and also during the whole of the braking period the heel of the right foot must be over the top of the sand punch, and by a series of intermittent downward pressures sand must be deposited on the rails. The air pressure should be gradually reduced as the tram approaches the stopping point, thus completing the stop without a jolt.

Any increase in air pressure during the slowing down period invites skidding ("flats" and collisions), and should an increase be necessary in an emergency the sand punch must be firmly held down until the stop is completed.

Quick stops with high air pressures, such as late bells, approaching intersections and bundy clocks, are not normally necessary. Such stops result in flat wheels and do not give credit to a driver's ability.

R. C. DRUMMOND,

25/1/1967.

TRAFFIC MANAGER.