

28th August, 1946.

STATE ELECTRICITY COMMISSION OF VICTORIA.

BALLARAT TRAMWAYS.

TRAMCAR EMERGENCY BRAKING.

The following is a brief description of the air-brake system and advice regarding all air brake trams owned by the Commission.

- (1) An electric motor compressor pumps air into two reservoirs where it is stored for use by the motorman as required.
- (2) The governor, which is actually an electric switch, is automatically controlled for the "on" and "off" positions by the amount of air pressure in the reservoirs, so that when the pressure drops to the predetermined minimum figure the switch closes and the compressor motor starts up and when the predetermined maximum figure is reached, the switch opens and the motor ceases to pump. This governor, therefore, maintains the required pressure in the reservoirs under normal conditions.
- (3) By the use of the motorman's brake valve handle (which can be likened to a tap) the motorman can, by turning the handle to the right, allow air to pass from the reservoirs to the brake cylinder, the piston of which through a system of levers forces the brake shoes on to the wheels.
- (4) The gauge in each motorman's cabin indicates the air pressure in the reservoirs which is always the same in each, being connected by an equalising pipe. The importance of the motorman watching the gauge should be obvious and should the pressure drop below 50 lbs. the hand brake must be used until the tram is taken from service. It is important that motormen be familiar with details of the compressor electrical circuit so that they may rectify minor faults, such as replacement of fuse, &c.
- (5) The hand brake is a manual means of applying the shoes to the wheel, and, although thoroughly reliable, it is slower and not so easy to apply as the air-brake.
- (6) The maximum braking effect is obtained when the pressure on the shoes will almost skid the wheels under conditions that give the greatest grip between the wheels and the rails and our air-brake has been so designed as to give this required effect. This fact cannot be too strongly emphasised as some motormen have resorted to other means of stopping their trams with results which have been far from satisfactory.
- (7) Continual daily practice in the intelligent use of the brake should fit motormen to deal with each situation of varying conditions that arise such as speed, load, and rail condition, but one outstanding feature may be stated with profit and we will treat the subject on the assumption that the rail condition is good at the time.
- (8) The greater the speed the less risk of skidding the wheels; therefore, at high speed a heavier application of the brake can be made than when travelling at lower speed, and, as the speed decreases, the pressure on the shoes must be reduced by allowing some of the air to be exhausted from the brake cylinder through the brake valve by turning the handle to the left.

TRAMCAR EMERGENCY BRAKING (CONT'D).

- (9) From the foregoing paragraph it will be seen that, in an emergency, in order to stop the tram as quickly as possible, the handle should be instantly turned to the right to an extent in proportion to the speed, that is, at full speed it should be turned to the full extent, which is the full emergency position.
- (10) In case of emergency when the rails are slippery, a brake application must be instantly made to the maximum extent consistent with the rail condition. Should the wheels lock and skid, release the brake momentarily and instantly re-apply but to a lesser extent than previously, and repeat if necessary until the tram is brought to a standstill or the danger is past. Sand must be applied throughout the period of braking.

In the event of the failure of the air brake, and there being insufficient time to bring the tram to a standstill with the hand brake, it is possible to stop the tram electrically.

Should such a case arise proceed as follows :-

Pull the reversing key back so that it is pointing in the opposite direction to that in which the tram is travelling and apply power on the first notch in series, and, in any case, not beyond the second notch. Should the retarding effect not be sufficient through the wheels spinning too fast, cut the power off and apply again, and repeat this process, if necessary, until the tram stops.

Should the circuit breaker open through the reversal of the motors, throw the power handle round to the last parallel position and leave it there until the tram is brought to a standstill. Remember! This operation is useless when a motor has been cut out.

In each of these two cases sand should be applied until the tram comes to rest. It is important to note that in each of these two cases the reversing key must be pointing in the opposite direction to that in which the tram is travelling and neither of these two means will hold the tram in a stationary position, so that, having been brought to rest when the wheel brake is useless, it would be necessary to put something in front of the wheels to prevent the vehicle from moving unless on level track.

TRAMCAR BRAKING.

All motormen before taking up duty must be familiar with the following questions and answers :-

BRAKE EQUIPMENT DESCRIPTIONS, ETC.

- Question 1: What is the purpose of the compressor?
ANSWER: To pump air from the atmosphere into the reservoirs.
- Question 2: What is the governor and its purpose?
ANSWER: The governor is an electric switch for automatically opening and closing the circuit to the compressor motor.
- Question 3: At what pressure does the compressor commence to work?
ANSWER: 60 lbs.
- Question 4: At what pressure does the compressor motor cease working?
ANSWER: 70 lbs.
- Question 5: When you know that electricity is in the overhead wires and the compressor does not work, what would you do?
ANSWER: Make sure that the compressor switch is closed and if so examine the fuse.
- Question 6: Before replacing a burnt out fuse what precaution would you take?
ANSWER: Open the compressor switch.
- Question 7: What is the purpose of the motorman's brake valve?
ANSWER: It has a dual purpose; firstly to allow the air to pass from the reservoir to the brake cylinder, secondly to exhaust the air into the atmosphere from the brake cylinder.
- Question 8: What is the purpose of the two air gauges situated one in each motorman's cabin?
ANSWER: To indicate the pressure in the air reservoirs.
- Question 9: What is the handbrake?
ANSWER: It is a mechanical brake by which the motorman can, by turning the wheel, force the shoes on to the wheels.
- Question 10: When is the handbrake to be used?
ANSWER: In the event of the failure of the air brake, and when leaving a tram at the termini or elsewhere on the road.

CONDITIONS AFFECTING BRAKING:

- Question 11: Under what condition could the brake be automatically freed from the wheels when standing?
- ANSWER: When a lightly loaded tram picks up a number of passengers.
- Question 12: What is the reason for this automatic freeing of the brake shoes?
- ANSWER: When the weight is applied to the tram, the shoes are forced down vertically and at a tangent from the wheels.
- Question 13: Under what condition could the brake of a standing tram automatically tighten when the brakes are on?
- ANSWER: When a heavily loaded tram discharges a great number or all its passengers at the one time. In this case the shoes rise vertically toward the centre line of the wheels, resulting in greater pressure between the shoes and the wheels.
- Question 14: Which is the most effective brake?
- ANSWER: The air brake.
- Question 15: Under what conditions should a heavy application of the air brake be made?
- ANSWER: When the tram is travelling at speed and the rail is in good condition.
- Question 16: What is meant by the rail being in good condition?
- ANSWER: When the adhesion between the wheel and rail is good.
- Question 17: Under what conditions would the adhesion be best?
- ANSWER: When the rail is thoroughly clean and wet.
- Question 18: When is the rail slippery?
- ANSWER: Generally after a light rain or when there is any substance on the surface such as oil, tar, leaves &c.
- Question 19: What would you do to counteract this slippery condition?
- ANSWER: Apply brake more gradually and apply sand to the rails by pressing on the sander button and release brake momentarily to allow wheels to revolve if they skid.
- Question 20: Is it your duty to see that the sand hoppers have plenty of sand and that the apparatus is working satisfactorily?
- ANSWER: Yes; these should be frequently examined, especially under conditions that are likely to make the rails slippery.
- Question 21: What is the minimum (lowest) air pressure at which you are permitted to use this brake?
- ANSWER: 50 lbs.

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CONDITIONS AFFECTING BRAKING:

Question 22: What precaution would be necessary when running a tram under this condition?

ANSWER: A greater distance must be allowed in which to bring the tram to a standstill as the force on the shoes would be somewhat reduced.

Question 23: Would you be permitted to travel as fast with the air brake out of order?

ANSWER: No; it would be necessary to travel more slowly and to allow plenty of time in which to bring the tram to a standstill.

Question 24: If wheels skid when brake is applied what must you do?

ANSWER: Release brake momentarily in order to allow wheels to revolve, apply brake more gently and use sand.

Question 25: Under what conditions must you allow a greater distance in which to stop tram?

ANSWER: (a) When tram is heavily loaded.
(b) When on down grade.
(c) When rail is slippery.
(d) When using hand brake.
(e) When approaching any obstruction.

PROCEDURES IN THE EVENT OF BRAKE FAILURE.

Question 26: How would a tram be stopped, moving in a forward direction, if air and hand brakes failed.

ANSWER: By pulling the reversing lever back and applying one notch of power, or if necessary two, at the same time using sand.

Question 27: What would be necessary if the wheels spun round and did not grip the rails sufficiently?

ANSWER: Throw the handle to the off position for an instant and apply the power, also sand, again, repeating the process if necessary until the tram has been brought to a standstill.

Question 28: If the circuit breaker opens when the motors are reversed, what should be done?

ANSWER: The power handle should be immediately thrown round to the parallel running position and left there until the vehicle comes to rest.

Question 29: Should sand be used when either of these two electrical means are used to stop the tram?

ANSWER: Yes; and should be used continuously until the vehicle comes to rest.

Question 30: If the tram is running backwards downhill, how would it be stopped.

ANSWER: In the same manner as described above except that the reversing key would be pointing in the opposite direction, that is it must always be pointing in the opposite direction to that in which the tram is travelling.

PROCEDURES IN THE EVENT OF BRAKE FAILURE (CONT'D.).

Question 31: How would a tram be kept from moving on a grade after having been stopped when there was no air or hand brake to hold it?

ANSWER: Some hard substance would have to be placed in front of the wheels, such as a big stone, piece of wood, draw-bar, etc.

Question 32: How would a tram descent a grade if both air and hand brake failed?

ANSWER: The circuit breaker should be opened, the reversing key pulled back, that is pointing up the grade, and the power handle turned round to the last parallel position and left there until the tram came to rest on the level track.

Question 33: With this means of stopping a tram, would it hold it in a stationary position?

ANSWER: No; because the electricity used in stopping it is dependent on the motion of the tram to generate the current.

Question 34: What happens when this means of stopping the tram is used?

ANSWER: The two motors are cross-connected so that the one is driven by the momentum of the tram and generates electricity supplied to the other motor which retards or stops rotation.

Question 35: Would it be possible to use this means of stopping the tram when one of the motors had been cut out?

ANSWER: No; as previously explained, it is necessary to have the two motors in working order and cross-connected.

Question 36: Would this means of stopping tram be effective if the pole were off trolley wire or if the electricity was off for any reason?

ANSWER: Yes; it is not dependent on power from the trolley wire.

LEAVING TRAM UNATTENDED ON A GRADE:

Question 37: If necessary to leave a tram unattended on a grade, what action would be necessary?

ANSWER: Release air-brake and apply the handbrake firmly, open the automatic switch, push the reversing key so that it is pointing up the grade and turn the power handle round to the last parallel running position after removing the trolley pole if daylight.