Copy sent to Mr. 23/-

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TRAMWAY BRAKES

GENERAL PRINCIPLES OF BRAKING:

It is essential that motormen be conversant, not only with the means of braking, but also alert to the widely varying conditions which have a marked effect upon braking efficiency. The principal factors which determine the distance required to stop a moving tram are speed, weight, gradient and rail surface. From this it is evident the shortest distance required would be when factors are slow speed, tram empty on up gradient, and clean rail surface. The greatest distance would be required when factors are fast speed, heavily loaded, down gradient and on greasy rail. The two dominant factors affecting braking are speed and rail surface, and the maximum retardation which can be obtained depends entirely upon the efficiency of the adhesion of the tram wheels to the rails. The stopping of a tram is, therefore, more easily and rapidly effected when the rails are clean than when damp and greasy. The efficiency of rail adhesion varies very considerably, as the rails become affected by the weather and seasonal characteristics. The best braking conditions exist when rails are being washed by heavy rain. A dry rail is not necessarily a clean rail, due to the crushing of debris, etc., by tram wheels, and the most adverse conditions for braking are caused by falling leaves, etc. These create very greasy conditions even in dry weather, but when light misty rain or dampness occurs simultaneously with leaves, the adhesion of the tram wheels to the rails is practically nil. Some localities of tram routes are more liable to trouble from leaves than others, consequently variations of conditions change not only with weather, etc., but also as to routes and sections of routes. The skidding of tram wheels is caused when the braking force applied to the wheels is greater than adhesive force or grip of the wheels upon the rails. It is, therefore, essential that motormen be fully alert to changes in rail conditions, and able to intelligently apply the brakes under all the circumstances met with in service and also on occasions of emergency. Since speed is the other dominant factor in respect to braking distances, it is also imperative that speed be adjusted by motormen to suit conditions. This is especially, therefore, applicable to street intersections, shopping zones, or any area of traffic congestion where an emergency stop may at any moment be necessitated to avoid an accident.

RAIL SANDING:

The provision of rail sanding apparatus on trams is made to enable motormen to increase the grip or adhesion of the tram wheels upon the rail surface. Since braking efficiency depends upon rail grip, harsh application of brakes requires maximum adhesion to rails. Under greasy rail conditions this is impossible, even with the application of sand, so that, under adverse conditions, harsh braking must on no account be used. Under adverse rail conditions, therefore, a slow and gradual application of brakes must be made, accompanied by sanding of the rail to prevent skidding and bring tram to a stop in the shortest distance possible. Accordingly, also, a greater distance must be allowed by the motorman for the stopping of his tram under these conditions, and driving speed adjusted to suit. It is important that motormen check their sand containers before leaving the depot, and also when taking over trams from other motormen. During adverse conditions, when sand usage is frequent, the supply available must be observed from time to time so that, if necessary, further supplies may be obtained.

BRAKE EQUIPMENT (HAND OR AIR OPERATED):

This equipment provides for retardation of the tram by the pressure of shoes upon the wheels. They are interconnected and operate the same mechanical links. The air brake in normal condition provides the most effective and reliable means of stopping trams in all circumstances, and is the only brake to be used. The air brake control valve permits a graduated application of brake pressure to enable the motorman to keep his braking force applied to the wheels within the limits of the rail adhesion of the wheels. Thus, by the avoidance of skidding, reduction of stopping distance is effected. Harsh braking, such as the full application of the air brakes by moving the valve to the emergency position, requires that rail adhesion must be good to stop in a shorter distance, and this may be assisted by sanding of the rails. Under adverse or greasy rail conditions, harsh braking is less effective than gradual braking, and must on no account be used. When skidding occurs it is an indication that braking pressure exceeds the limit of rail adhesion present, and brakes must be released and re-applied gradually, together with sand, to bring tram to a standstill. Since the wheels must turn or be free to turn to permit of effective braking, the application of one notch of series power, together with partial release of brake pressure, may be effective in overcoming skidding tendencies on bad track surfaces. This requires intelligent application.

BRAKE FAILURE:

Only in the event of breakdown of the mechanical brakes which makes them inoperative should motormen use electrical means of stopping tram. There are two methods of stopping by electrical means - Reverse Motor Action and Regenerative Motor Action. The former, as its name indicates, is the power reversing of the motors. This is effective at speeds not exceeding 5 or 6 m.p.h., and on no account must power of more than one or two notches in series be applied. The latter action depends upon the driving of the motors by the tram wheels for its retarding effect. The application of this regenerative action may be the signal to reverse motor action by the quick movement of the controller to full parallel position, if the circuit breaker "blows" or opens. The action obtained is that one motor acts as a generator and tends to stop and reverse the other motor. On good rail surface it is effective at speeds in excess of 5 or 6 m.p.h., also to control speed of tram on a gradient to permit motorman to place an obstruction to the wheel to hold the tram. On a greasy rail surface, both electrical means of stopping trams, by reason of their harshness, are conducive to unrestricted skidding, so that sand application is important. Trams will not hold stationary upon a grade, except by the mechanical brakes; therefore, if it should be necessary to apply electrical means to stop a tram, an obstruction such as angle iron, drawbar, etc., must be placed to rail to hold the tram.

NOMENCLATURE:

The definitions and references to brakes, etc., contained in the "Local Instructions" issued in conjunction with the Commission's Rules governing employees (April, 1939) are now cancelled. In future, all references will be g iven as follows :-

Hand Brake: Used for parking tram instead of air brake if tram to be left unattended in thoroughfare. Also becomes service brake if air pressure system fails.

Service Brake: Air brake. Slow or graduated application by movement of control lever to first position at right as required.

Emergency Brake: Full application of air pressure by quick movement of control lever to the extreme right position. Sand application to rails if necessary.

Reverse Motor Action: Not to be used except upon breakdown of the mechanical brake. Controller key reversed and power handle moved to first or second series notch only. Speed not in excess of 5 or 6 m.p.h.

Regenerative Motor Action: Not to be used except upon breakdown of the mechanical brake. Controller key in reverse position. Circuit breaker open and power handle in full parallel position. Sequel to Reverse Motor Action if circuit breaker blows or pole off trolley wire. On good rail effective at speed in excess of 5 or 6 m.p.h. Effective control for tram on gradient by one man operator to permit placing of obstruction in front of wheels.