ment impervious to moisture. If cracks appear these are painted with tar and sanded so that they, too, disappear, and they do not crumble under traffic. The treatment, in short, overcomes the more objectionable features of the concrete pavement.

Concrete pavtments as heretofore laid in Ontario have cost about $1.15 a square yard. The tar treatment has cost about 2 cents a square yard, and the treatment has been found to last for two years, making the cost of tarring and sanding 1 cent per square yard per annum. If further experience proves the success of this treatment, it should be useful for the smaller towns and villages in paving their main business streets, and would be exceedingly effective for main highways radiating from large cities.

CONTROLLING BRAKES FOR TROLLEYS ON TRANSFER BOOMS.*

By Frey Broberg.

The design of controlling drums and brakes for trolleys on transfer booms, carrying automatic buckets, is naturally dependent upon the effect on the controlling rope, which holds the carriage at any point on the boom for the purpose of taking on or dumping a load.

As most of us know the automatic bucket is operated by two ropes, the closing and holding rope. The former, when pulled, closes the bucket and carries two-thirds of the total load when bucket is hoisted in order to keep the same closed. The office of the second rope is to carry the remaining third

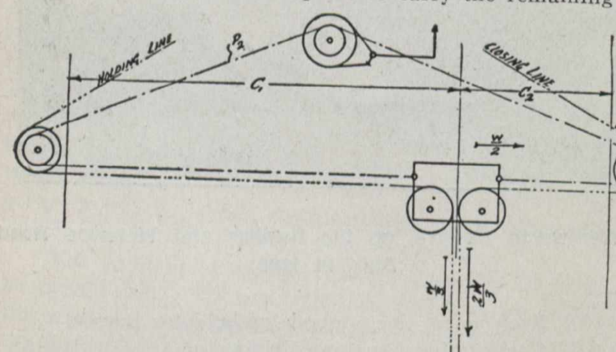

Fig. 1.

of the load and keep the bucket suspended when the pull on the closing line is released at dumping.

In order to move the trolley or bucket carriage back and forth on the tracks of the boom, without an extra engine, the difference of tension in the above mentioned ropes is brought into use.

The holding line is carried from the trolley round a sheave placed at the loading end of the transfer boom and is led from here to the engine via various sheaves, according to conditions. The closing line on the other hand is carried from the trolley round a sheave at the dumping end, as the sketch shows. An endless line, wrapped a few times around the controlling drum is the controlling rope. The drum can be placed at any convenient point.

To brake this drum and thus make the trolley stop or retard its motion, at the operator's will, a foot-lever is placed near and from here the pressure of his weight is carried through an arrangement, very much like the arrangement of block signals in a railway yard, to the controlling drum, and is ultimately transferred into friction between the brake-band and the controlling drum.

*From Industrial Engineering.

There are two ways to operate a transfer boom of this design. One way is to have the controlling drum braked constantly and only partly release the brake in order to move the carriage. The other way is to keep the brake released and only bring the brake in action when it is desired to stop. It has been found that this latter method is more practical and efficient than the first method because it is difficult for one man to operate four levers simultaneously. The levers are one steam throttle (or electric switch, if electric power is used), two friction levers and one lever for the controlling drum. By using the second method it is not necessary to operate these levers at the same time.

It is true that by working a carriage with this method more strain is exerted on the controlling rope, but only one man is needed.

Because a drum working under these conditions has to stand harder service and because this is the way mostly employed by operators of "Transfer Booms," "Boston Towers" and Gantry Cranes, we will analyze the effect when the second method is employed.

To ascertain this effect the movement of the trolley is divided in two cycles. The first cycle extends from the beginning to the point at which the operator begins to retard the motion. The second cycle starts at this point and prevails until the trolley is brought to rest. The length of the cycles are, of course, subjected to the operator's will. The longer the second cycle the less power is needed on the brake, but more time is used.

By marking:

D = Total distance of travel.

C_1 = First cycle of movement.

C_2 = Second cycle of movement.

W = Total load.

$W_1 = \frac{W}{3}$ = Strain on holding line.

$W_2 = \frac{2W}{3}$ = Strain on closing line.

$P_1 = \frac{2W}{3} - \frac{W}{3} = \frac{W}{2}$ = Force of acceleration in first cycle.

P_2 = Constant retardation force in second cycle.

V = Initial speed in first cycle = 0.

V_1 = Finishing speed in first cycle.
= Initial speed in second cycle.

V_2 = Finishing speed in second cycle.

F_1 = Acceleration in first cycle.

F_2 = Retardation in second cycle.

E = Effect on rope at end of first cycle.
= Effect on rope at beginning of second cycle.

G = Acceleration of gravity.

T_1 = Time of first cycle.

T_2 = Time of second cycle.

By applying the known quantities to the equation, the acceleration due to the weight and constant power is found. Having the initial speed, the found acceleration and space of travel, the time is found for the first cycle. In the second cycle the initial speed is, of course, identical with the finishing speed of the first cycle and the finishing speed of the second must be nil. Space is known and with the speed time is found.

It is obvious that the sum of the effects of power and speed and time of both cycles must be equal to 0 to insure perfect rest of trolley.