decrease in the rate of returns on investment are: increased operating costs due to increase in cost of labor and material; increase in cost of rolling stock, due to heavier and better-equipped cars; increased number of roads, causing in several cases competition and division of traffic. The possibility of increasing returns by reducing the operating costs are not great. Electric railways have reached a limit of economy in the management of their affairs consistent with safe and efficient operation. If the costs of labor and material continue to advance, the operating costs will increase.

The returns may be increased by the abolishing of passes, abolishing of transfers, the increase in rate tariffs, and by pioneer work developing more frequent and longer hauls. In 1902 the average percentage of net income to capital stock of American railways was two per cent. Five years later this had decreased to 1.6 per cent.

From evidence given before the Railway Commission of Wisconsin it would appear that the average dividends of the Milwaukee Electric Railway and Light Company was 3.23.

The longest ride possible in Milwaukee in 1890 was four miles, and the fare five cents or one and a quarter cents per mile. In 1910 the longest possible ride is twelve miles, and the fare four cents, or one-third of a cent per mile. That is, the length of ride in twenty years has increased two hundred per cent.; the time consumed in travelling the increased distance is one hundred per cent. more, and the rate of fare has decreased seventy-five per cent.; that is, the passenger to-day pays about a fourth of what the passenger paid twenty years ago.

In Glasgow, Scotland, the average rate of fare per mile is about nine-tenths of a cent, and, since this city is held up as a model for successful operation of tram cars, it will be noted that the fare is higher than in many American cities. The population is denser and the rate of wages lower than with us.

EDITORIAL NOTES.

An interesting matter of valuation has arisen in the matter of the South Station of Boston. It cost to construct a little over $15,000,000. The holding company is capitalized at $500,000, and the property is bonded for $14,000,000. During the last fiscal year the net loss to the corporations operating was $672,445. By agreement, one corporation is to pay 75 per cent. of the interest, taxes and operating cost, and another, 25 per cent. A new valuation has been made of the property, which will be several million in advance of the cost of construction. The new valuation may be justified from the returns, but in the matter of taxes the railways will fail to see the justice of the new rating. This case illustrates again the difficulty of properly apprising property separate from its surroundings and its value because of its connection with other property.

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The Universal Portland Cement Company, of Chicago, have recently adopted a voluntary accident relief plan for the benefits of its employees. Their plan of relief corresponds very closely to those that have been in operation among the subsidiary companies of the United States Steel Corporation. The money needed for the fund will be furnished entirely by the company without any contribution from the workmen. It is only an experiment for the year 1910, but should it work out successfully, it is expected it will be continued from year to year.

Two special trains conveying delegates from the Brotherhood of Locomotive Engineers' Convention at Detroit to Niagara Falls, and running half an hour apart, on May 21st, made record runs. No stops were made on the 224-mile trip, but there were three slow-downs. The first train covered the 224 miles in 224 minutes, while the second covered the distance in 217 minutes. Each train had twelve coaches. For heavy passenger trains, and for such a long distance, this is probably the worlds record.

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The Canadian Engineer wishes to extend to Dr. Charles A. Hodgetts, secretary of the Ontario Board of Health, congratulations upon his appointment as Medical Adviser to the Canadian Conservation Commission. The Commission are singularly fortunate in being able to secure the services of a man who is not only an able administrator, but a scientist.

NOTES ON THE DESIGN OF A RADIAL INWARD-FLOW HYDRAULIC TURBINE.

By Claud H. Hill, A.K.C.

In this type of turbine the water does the work partly by its pressure and partly by its velocity, exerting a couple on the wheel which rotates the shaft, thus making the energy in the water available. This working couple is arrived at in the following way (see Fig. 1):—

Let C = couple in foot pounds.
t = time in seconds.
Ω = angular velocity.
W = weight body.
g = acceleration due to gravity.
v_1 = velocity at A_1.
v_2 = velocity at A_2.
O = centre about which body is turning.
r_1 and r_2 = perpendicular distances from o.
p_1 and p_2 = distances of A_1 and A_2 from o.
μ_1 and μ_2 = resolved velocities perpendicular to p_1 and p_2.
α and β = angles between v_1 and μ_1 and v_2 and μ_2, respectively.

Let the couple C act on the body of weight W for t seconds, and in this time change its velocity from v_1 to v_2 and its position from A_1 to A_2.

The angular impulse = Ct, and if the change is reckoned for one second, angular impulse = C. Also, angular impulse = change of angular momentum.

$$\text{Therefore, } C = \frac{W}{g}(v_2 r_2 - v_1 r_1) \qquad (1)$$

Now $r_1 = p_1 \cos \alpha$, $r_2 = p_2 \cos \beta$.
and $v_1 = \mu_1 \sec \alpha$. $v_2 = \mu_2 \sec \beta$.

$$\text{Therefore, } C = \frac{W}{g}(\mu_2 \sec \beta\, p_2 \cos \beta - \mu_1 \sec \alpha\, p_1 \cos \alpha).$$

$$C = \frac{W}{g}(\mu_2 p_2 - \mu_1 p_1) \qquad (2)$$

Thus the water in passing through the turbine has its angular momentum diminished, and exerts a couple = — C, tending to rotate the wheel, which is equal and opposite to the couple C the wheel exerts on the water.

Hence, the couple C tending to rotate the wheel $= \frac{W}{g}(\mu_1 p_1 - \mu_2 p_2)$.

Now the work done per second = $C\,\Omega$.