A SATISFACTORY METHOD FOR MEASURING THE COEFFICIENT OF FRICTION BETWEEN RUBBER TIRES AND ROAD MATERIALS

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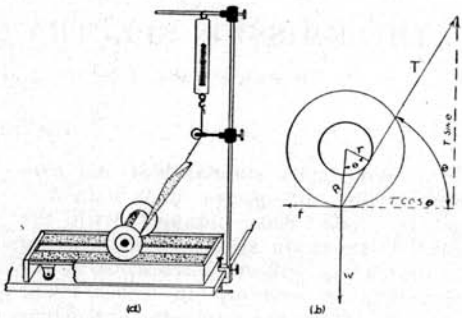
A short time ago Professor R. F. Paton of the University of Illinois presented a paper before the Illinois State Physics Teachers Association on a proposed "Friction Spool Experiment". It was suggested in that discussion that the friction spool could be used to determine the coefficient of friction between the spool and any material placed under the spool. It occurred to the writer immediately that the friction spool could be so constructed that one could determine the coefficient of friction between rubber tires and road materials. Two rubber tires, eight inches in diameter, were purchased and a wooden cylinder was turned to such a diameter that the tires would fit securely over the ends. One end of a strip of canvas was tacked to the cylinder, while the other end was attached to a wire hook so that a cord could pass from the hook under a pulley and be attached to a pair of spring scales hanging in a vertical position, as shown in fig. 1a. It was shown in Professor Paton's paper that there was an angle θ at which the tension T in the canvas could be applied so that the spool would slide on the surface under it instead of rolling. It was shown further that the condition of equilibrium when the spool was sliding required that the force of friction between the spool and the surface under it, the weight of the spool W, and the tension T in the canvas must intersect in a point when represented by vectors, as shown in fig. 1b. It is easily seen from the diagram that the force of friction f is given by T cos θ, while the pressure of the spool on the road is given by W — T sin θ. Therefore, the coefficient of friction μ is given by



$$\mu = \frac{T \cos \theta}{W - T \sin \theta} \qquad (1)$$

Since it was desirable in this experiment to apply different weights to the road surface, a round hole was made along the axis of the wooden cylinder so that cylindrical weights of approximately

	W	θ	T	T Cos θ	T Sin θ	μ
	1740	61.3°	1350	648	1183	1.163
	2793	61.4°	2150	1029	1888	1.138
	3837	61.1°	3100	1508	2717	1.343
Glass	4906	61.1°	3900	1895	3420	1.277
	5945	61.2°	4900	2369	4295	1.435
	6998	61.3°	5750	2780	5041	1.420
	1740	61.3°	1350	648	1183	1.163
	2793	61.3°	2150	1033	1889	1.142
	3837	61.1°	3000	1448	2627	1.195
Wood	4906	61.3°	3800	1827	3330	1.159
	5945	61.5°	4600	2190	4040	1.151
	6998	61.4°	5400	2586	4742	1.148
	1740	61.3°	1250	601	1097	.934
	2793	61.6°	2000	950	1757	.916
	3837	61.6°	2750	1308	2416	.920
Concrete	4906	61.2°	3500	1684	3067	.915
	5945	61.5°	4250	2027	3734	.915
	6998	61.0°	5000	2423	4373	.923

1000 grams each could be placed along the axis of the spool.

It was also found desirable to place the road materials on a small truck provided with rollers so the road could be moved in a horizontal direction under the spool, as shown in fig. 1a.

Since the tires may flatten as the load is increased, the angle θ may not be quite the same for all loads and should therefore be measured in each case.

The readings and calculations for a few road materials are shown in the following table.