He should be employed by the day so that he may be liable to discharge at any time for neglect of duty. He should be selected by competitive bids for day labor of eight hours per day.

Man and team could be secured for nine months' service at the rate of $1.50 or less per day. The rate at present paid by our county commissioners for man and team is $2.50, because they are employed for but a few days at a time. And for this $2.50 a man is secured who takes no interest in the road and who piles on the material because it is easier to draw gravel than to spread it, and because it makes his job last longer.

To secure the adoption of such a system for our gravel roads requires only that county commissioners should be convinced that it is more desirable as well as more economical than present methods. They have full powers to act.

For our township roads it requires that all road taxes should be paid in money instead of in day labor as at present. The day-labor system produces the same kind of results that would be secured by a school system if the citizens assessed were permitted to work out their school taxes by taking turns in teaching the public school. When road taxes are paid in money, the division of township roads into sections, and the employment of attendants, will solve the road problem.

This method of maintenance by an attendant who devotes all of his time to the road, is in use in isolated cases in the United States, principally in New York State. In European countries it is acknowledged to be the only satisfactory method of maintenance, and it is the basis of the superb system of highways enjoyed by France and Germany.

Some Tests on Ball Bearings. By M. J. Golden.

These tests were made to determine the amount of power absorbed by ball bearings of the form used in supporting shafting and spindles, when the load is light. The bearing, in this set, was loaded with weights that varied from ten pounds (the weight of the parts) to three hundred pounds, by increments of forty pounds, except the last one; that was ten pounds. The apparatus used is shown in the sketch, where (A) is a spindle that is revolved by means of a belt from a counter-shaft. To this spindle is attached (B), the inner part of the ball race; the outer part

of the race being held in a cage (D) that is clamped inside the balanced arm (E). Near the extremities of the balanced lever are inserted knife edges that are on a line drawn through the center of the rotating spindle, and the weights used were suspended from these knife edges, as shown.
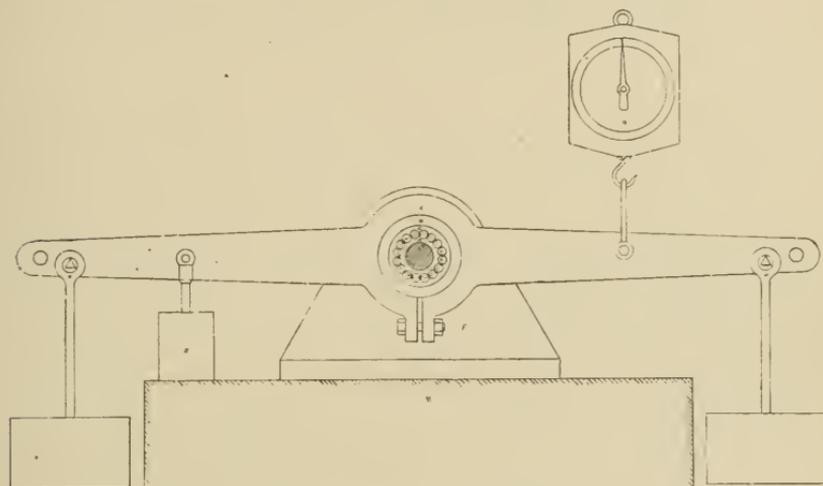
A dash-pot (H) was used to check the vibration of the lever; and the tendency of the lever to rotate, due to friction with the revolving spindle, was measured on a scale (G).

The method of operation was to first bring the lever nearly to balance, leaving a slight excess weight on the scale side, then on causing the spindle to rotate there was an additional pull on the scale arm, due to the friction of the moving parts. This additional pull, when reduced to the ball path on the part (c), could be used to find the coefficient of friction.

The following table will show the form of log kept:

BALL-BEARING FOR ONE INCH SHAFT.

(Oil Used.)

No.	Weight on Scale. Ounces.	Weight. Pounds.	Rev. Spindle.	Time. Seconds.	Heat.	Coefficient F.
7	¼	90	256	30	None.......	.0017
8	¼	90	442	30	None	.0017
9	⅜	90	757	30	None.......	.0026

(Oil Used.)

No.	Weight on Scale. Ounces.	Weight. Pounds.	Rev. Spindle.	Time. Seconds.	Heat.	Coefficient F.
10	$\frac{3}{8}$	130	256	30	None.......	.0018
11	$\frac{3}{8}$	130	431	30	None.......	.0018
12	$\frac{3}{8}$	139	758	30	None.......	.0018

Three sets were made for each load, and, with the weights used, the coefficient of friction varied from .0017 to .0022, as averages for the three sets. Of course, the width of this range may be due to inaccuracy in reading from the scale, as the variation in pull on the scale arm caused a rapid vibration of the scale index.

The bearings used were those supplied on the market for carrying shafts, and the principal cause of the jar in the apparatus during the test was due to slight inaccuracies in grinding the races.

In another set of tests, where the load was increased to seven hundred pounds, it was found that somewhere between the six hundred and the seven hundred pounds load the balls and races had become pitted, small pieces of the hardened steel being torn from the surfaces. These pieces were found in the race-way or in the oil that was used. It was found, further, that the tendency to heat was much reduced when oil was used and that the whole movement was smoother and steadier.

FURTHER STUDIES IN THE PROPAGATION OF SOUND. BY A. WILMER DUFF.

[Abstract.]

In a previous paper the writer gave a theoretical discussion of the propagation of sound in spherical waves, allowing for the effect of the viscosity of the air and the conduction and radiation of heat from the condensations and to the rarefactions. It resulted from this investiga-