two years between Brighton and Kemptown with a total mileage of 70,000, and has shown a saving of from 121/2 to 15 per cent. in the consumption of fuel, which saving has been obtained under most disadvantageous circumstances, inasmuch as the engine has to be kept in steam for about 16 hours per diem, whilst its actual running time is under seven hours. The tramway car, fitted with ordinary bearings, and weighing 2 ton, 15 cwt., was let loose from a point 56 feet up an incline with 1 foot 61/4-inch rise; it ran down this incline, and 57 feet on the level line at foot of same, or a total distance of 113 feet, the force expended was therefore 6,160 pounds, falling through 1.521 feet or 9,364 ft. lbs., the average frictional resistance was 9,364 divided by 113, or nearly 83 pounds, equal to 30.5 pounds per ton. A similar car fitted with roller bearings being let loose from the same point ran the full length of the level line available, namely 320 feet, and had not then quite come to rest. The total distance traversed being 376 feet The force expended was about 9,364 feet pounds, average frictional resistance was 9,364 divided by 376, equals 24.9 pounds, or about 9 pounds per ton of load, a saving of 72 per cent. Relative starting effort of a tram-car on a gradient of 1 in 20; ordinary bearings, 100; roller bearings, 77; saving 23 per cent. on a gradient of I in 80; ordinary bearings, 100; roller bearings, 50; saving 50 per cent. on a gradient of 1 in 140; ordinary bearings, 100; roller bearings, 39.6; saving 60.4; results which require no comment.

Perhaps one of the most interesting among the general application of these bearings is that of the big bell at St. Paul's Cathedral, London, Great Paul, which with its head stock and other moving parts weighs nearly 25 tons, and which gave considerable trouble when mounted on ordinary bearings. The following results are instructive. When mounted on ordinary bearings the bell came to rest after the swinging effort had been discontinued, within one minute, when on roller bearings 6 minutes 55 seconds, showing that the frictional resistance of the latter was only about 1-7 of the former; a result remarkably in accordance with the starting effort tests given under the head of tramways.

With reference to the question of heating, it is an interesting fact that there has not been a single case of a hot bearing in all the experience so far gained with roller bearings. Although it is somewhat early to predict what the cost of maintaining these bearings will be, the results so far show that if they are constructed of suitable material, it will be extremely low. It has been found that polished and pressed stee) or cold rolled steel is the best material for the rollers, and the boxings lined with steel have been proven by the writer to be far superior to cast-iron boxings. In all cases, if at all convenient, the boxings should be of the oscillating type to ensure perfect alignment.

## SLOW SPEED MOTORS DIRECT CONNECTED TO MACHINE TOOLS,

One of the most important applications of electricity nowa-days is its employment to distribute power from the prime mover to the various machines to be operated. In this way a driving shaft of all sizes and types of tools, the motors being part of the tools themselves. These motors do not at all interfere with the operations of the cranes now found in every well-appointed factory by preventing them from dropping the piece into the tool itself. Great advantage is claimed to exist in cases in which electric driving by direct connected motors are used on machines required to be driven intermittently.

• Among the advantages of direct connected motors is that of cost, as the price of a motor depends as much on its speed as on its horse-power. For instance, there is quite a difference in the price of two motors of equal horse-power, one geared to the tool and running at say one thousand R.P.M., and the other mounted directly on the driving shaft of that tool and therefore running at the same speed, which may be as low as one hundred R.P.M. In the case of the geared motor its speed is too high to attach directly to the tool, and hence reducing gears have to be used, which is a somewhat-uneconomical and noisy method of driving, besides requiring more floor space for the motor. The makers of slow speed motors urge that the cost of these gears or the speed-reducing devices must not be lost sight of in making the comparison.

Some of the advantages claimed to be obtained by the use of direct connected slow speed motors are: All expense for power ceases the instant the switch is opened and the motor stopped; the tool can be located anywhere irrespective of lines of shafting;



MOTOR DIRECT CONNECTED TO 26 IN. ENGINE LATHE.

a much higher rate of output for the tool and machinist is possible; these motors occupy the space and take the place of the driving pulley on the tool; they are compact, protected from injury, moisture and dust; tools thus equipped can generally be run after the engine has shut down by connecting through a switch to the mains of a local central station; special tools equipped with direct connected motors may be moved readily to the piece they are to do the work on; the exact amount of power used by each tool can be accurately measured at any time by the use of instruments indicating electric current; the life and usefulness of a motor is greatly increased by running it at a slow speed; the use of electric transmission permits the generating units to be large, and to be concentrated near the boilers at that point most con mient for handling the supply of fuel.

The Jones & Moore Electric Co., Foronto, is Canadian agent for the Bullock type of slow speed motors.

## SPEED INDICATORS.

Woodman's and Hudson's patent improved speed indicators, manufactured by the R. Woodman Manufacturing and Supply Co., 63 Oliver street, Boston, Mass., U. S. A., are now attracting a great deal of notice. The attention of dealers and others using and selling machinery is invited to the qualities which



combine to make this indicator, its makers claim, preferable to any other in use. It is adapted to pointed or hollow centers and has a raised sight on dial so as to count by touch, which is of great importance, especially in dark places, as it is only necessary to look at your watch and count the number of revolutions the dial makes, which, with the fractions, will be the exact speed



MOTOR DIRECT CONNECTED TO BORING MILL.

plant can be enlarged at small expense by the addition from time to time of motors as the machines required to be driven are installed. There are now many factories in this country which are equipped with slow speed motors directly attached to the