thermore, to the complication of double overhead trolley required for this type of motor.

During the past few years there have been developed several types of single phase alternating current motors having speed-torque characteristics even better adapted for railway work than that of the direct current series motor, and, furthermore, providing ample starting torque with any voltage variation liable to occur in practical electric railway operation. As these motors can be operated with a single trolley and ground return, and can, furthermore, be operated satisfactorily on either direct or alternating current, it makes their field of usefulness much greater than their direct current series competitor.

Having such a motor with practically no restriction as to voltage, it is possible to break away from the exclusive field of electric traction with frequent service and small units and consider the operation of freight and passenger trains over our regular steam lines. In order to arrive at some general conclusions not limited by the local considerations of a specific case, this paper is devoted to a somewhat brief and general discussion of the operation of our steam lines by the alternating current railway motor.

To make the conclusions general, trains of different weight have been taken, operating at different speeds and varying headway over a level track. As being typical, train weights of 2,000, 1,000, 500 and 250 tons of 2,000 lbs. have been selected. As the investigation of the operation of these trains will be carried to maximum speeds of 60 to 70 m.p.h., the total friction of the train expressed in pounds per ton is given in curve sheet 1. This friction is not that of the trailing load, but includes the running and wind friction of the locomotive itself.

From a number of tests a steam consumption of approximately 30 lbs. per I.H.P. hour is taken as the basis of all locomotive work. It is assumed that locomotives are compound, as this steam consumption could hardly be expected with simple engines under average conditions. To make all results comparable further assumptions are made of an evaporation of 7 lbs. of water per pound of coal, an engine efficiency of 85%, and cost of coal at $2.00 per ton of 2,240 lbs. The price of fuel will vary and this is considered later. As we are figuring upon actual performance of the locomotive, that is work done in overcoming train friction, it will be necessary to introduce a factor allowing for coal wasted in making up and damping fires, and general waste incident to locomotive practice when standing idle for a large part of the twenty-four hours. Furthermore, a steam locomotive is called upon to operate throughout the year at varying temperatures of the surrounding air, and coal consumption during the winter months is in excess of that during the summer. This excess may reach 20% as an average during the cold