

THE MILWAUKEE ELECTRIFICATION

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This contribution briefly points out the success of the Milwaukee installation and shows the reason for the adoption of the 3000-volt as the trolley potential.—EDITOR.

The electrification of heavy railway service has been undertaken in many instances for a somewhat limited purpose, and under conditions that were fairly uniform as to the requirements, with either grades or substantially level track being the particular characteristic of each installation. The Butte, Anaconda & Pacific, and more particularly the Chicago, Milwaukee & St. Paul, are illustrations of heavy service over long heavy grades, as well as on extended stretches which are practically level. The requirements as to speeds and the handling of trains are, naturally, more varied over a profile of this character than where the gradient is more nearly uniform.

The Chicago, Milwaukee & St. Paul is, presumably, the best illustration extant of electric operation with widely varied service over many changes of grade. To eliminate the Rocky Mountains, and also keep faith with the prairie, is no small accomplishment. The impressions from traveling on the Milwaukee are in keeping with the country it traverses, and a more intimate acquaintance than is possible from a description is essential to a full appreciation. There is merit not only in the operating success, but also in the initial investment, as figures published by the Railway Company show something less than \$30,000 per mile of route.

The distinctly novel feature is regenerative control,—utilizing the locomotives as gravity driven power houses for the purpose of regulating the speed on down grades, the flexibility of regeneration as applied to direct current equipment being such that the air brakes are not used during the run, but are applied only for the purpose of stopping the train. The variable characteristic of the direct current motor permits a variation in speed in proportion to the grade, conforming closely to the established rules under former operation with the air brakes. The smoothness of grade running with regeneration, and the absence of hot brake shoes and wheels are details needing but mention to be appreciated. Incidentally, under some cir-

cumstances, the return of energy available for the hauling of other trains may be an item of considerable moment.

The decision in favor of 3,000 volts d.c. for the Milwaukee followed a careful study of the relative cost and other features of split phase alternating current and other direct current voltages, commonly considered as being indicative of the type of locomotive and equipment. This review showed figures and operating characteristics favorable to direct current, with but little difference in the investment between 3,000 and 5,000 volts d.c.; intermediate voltages and those lower and higher being rather less favorable. There was this difference, however, between 3,000 volts and 5,000 volts: the investment for copper in the former was transferred to investment for locomotives in the latter, and obviously feeder copper is subject to less depreciation and maintenance than in the case of rolling stock. Further, as the investment for substations and copper was sufficient for a material increase in traffic, such locomotives as might be subsequently purchased, if built for 5,000 volts, would continually add the burden of a higher cost.

The vital problem of collecting the current at 3,000 volts required by the heavy freight and high speed passenger service has been successfully solved, and with ample margin. The locomotives are provided with two pantographs in the expectation that both would be used, but in practice it has been found that one is sufficient, leaving the other as a reserve.

The results on the Butte, Anaconda & Pacific have shown conclusively the success of electrification in heavy service with a substantial reduction in the cost of operation as compared to steam locomotives. The success of the Milwaukee is unquestionable as to the service performance, and the economic results will be awaited with much interest. There can be no question as to the demonstrated ability of the electric locomotive to outhaul and outdistance its steam associate.