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A View on the Chicago, Milwaukee & St. Paul Railway. We publish in this issue an interesting account of the 3000-volt direct-current electrification to be carried out by this Railway

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THE PATHS OF PROGRESS

It is particularly gratifying that we are able to announce the closing of so large and important a contract for steam road electrification as that of the Chicago, Milwaukee & St. Paul Railway in this the first issue of a new year. We have included in this issue also a brief description of the 1500-volt direct-current electrification of the Ontario Municipal Electric Railways, and the 2400-volt railway of the Bethlehem-Chile Iron Mines Company. We feel that the very fact that such important work as the above undertakings represent is being actively pushed at the present time should be a distinct encouragement, as showing a marked improvement in the industrial and financial conditions and a faith in the immediate future of the economic status of the country.

The electrification of the Puget Sound Lines of the Chicago, Milwaukee & St. Paul Railways is the most important steam road electrification ever undertaken or even seriously contemplated; in fact the letting of this particular contract would seem to mark a new era in electric railway work. The initial work includes the electrification of one complete engine division 113 miles in length and the total mileage, when yards, sidings, etc., are considered, amounts to 168 miles. This work is already under way and in the early future, if the initial work proves successful, three additional engine divisions will be electrified, making approximately 440 miles of main line track or a total of 650 miles, when yards, sidings, etc., are included. It would appear that all this work is well assured and plans are even being made to extend the electrified zones to the coast which would mean 850 route miles of main line steam road converted to electric operation.

One of the most interesting, and at the same time most important features concerning this large contract is that the change in motive power is not being brought about by any local conditions such as the necessity of abating the smoke nuisance, but is being made by the railway company on the straight plea of the economies that are to be secured by electric traction. The operating results of the Butte, Anaconda & Pacific Railway, which we published in the November issue of the REVIEW, would indicate that there is every justification for anticipating economies that will more than offset the added interest charges on the capital to be expended in effecting the change.

The whole engineering world that is interested in railway work will undoubtedly pay special attention to the fact that the three contracts we have mentioned in this editorial are all to be operated at higher direct-current potentials. The Chicago, Milwaukee & St. Paul Railway will operate at 3000 volts, the Ontario Municipal Railways at 1500 volts, and the Bethlehem-Chile Iron Mines Railway at 2400 volts. It surely must be considered a most significant fact that, in such a very great percentage of the large contracts that have been placed during recent years in this country for heavy traction work, higher direct-current potentials have been specified. The reason for this is undoubtedly the success that has already been achieved with direct-current apparatus working at higher voltages. The very fact that the Chicago, Milwaukee & St. Paul Railway Company has adopted a trolley potential of 3000 volts shows that the limit had not previously been reached where economies could be secured by increasing the trolley potential without sacrificing any of the vital attributes of traction work, such as safety, reliability of operation and an all-around efficiency.

Another point of great interest concerning two of these electrifications, namely, the Chicago, Milwaukee & St. Paul and the railway of the Bethlehem-Chile Iron Mines Company is that the locomotives are to be provided with regenerative control. On an electric railroad scheme of the magnitude

of the Chicago, Milwaukee & St. Paul Railway distinct operating advantages should result from the provision of electric braking for the heavy trains on the steep down grades, necessarily encountered in railroad work in such mountainous regions. This is distinctly in line with the "safety first" policy of modern railroading, as electric braking removes any danger of accident due to overheated brakeshoes and wheels, and furthermore results in power economy and a lower cost of maintenance.

The direct-current railway motor has long been recognized as the most reliable, efficient and flexible means of delivering power to the drivers of a locomotive and now that direct-current regenerative braking has become an accomplished fact it makes the high voltage direct-current system most admirably fitted to fulfill all the requirements of general steam railroad electrification. We consider the introduction of electric braking, while still retaining the well tried and proved direct-current apparatus, to be a distinct step in the advance of the art.

Referring to the Chicago, Milwaukee & St. Paul electrification, each locomotive, of 260 tons local weight, will have 200 tons on drivers, an equipment of eight motors, having a combined rating of 3440 horse power, and a hauling capacity of 2500 tons trailing load on a one per cent grade at a speed of approximately 16 miles per hour. This great hauling capacity, combined with such a high speed on ruling grades as 16 miles per hour, is of particular interest to the steam railway operator who has been educated in the school of Mallet operation, in which speeds as low as seven miles per hour constitute frequent practice. The introduction of such an advanced type of motive power should result in somewhat radical changes in the methods of operation standardized with the use of the steam engine.

The adoption of a trolley potential of 3000 volts enables an economic distribution of the feeder copper with the spacing of substations 35 miles apart. The reduction of the necessary substation apparatus that will be secured in this manner, in spite of the fact that such heavy trains are to be hauled up mountain grades, brings the cost per mile of track electrified down to a very reasonable figure, and further, it emphasizes the sturdy capabilities of the direct-current substation apparatus.

Mr. A. H. Armstrong in his article shows the ample provisions that have been made for power supply, and that owing to favorable local conditions the railway company has been enabled to enter into a contract whereby energy will be supplied at 0.536 cents per kw-hr. based on a 60 per cent load factor. Such figures for energy, even when taken in bulk, are unusual and can only be obtained in cases where the hydro-electric resources have been so wisely conserved and so thoroughly developed as in the case of the Montana Power Company. If such thorough developments take place in other localities it will play an important part in stimulating the further electrification of our steam railways.

As we said at the outset, we hope that work of such a magnitude as that described in this issue being undertaken at this time will encourage others to look on the bright side of present conditions. As this is the first issue of a new year, it seems appropriate to express the hope that 1915 may be full of prosperity and that we may have the pleasure of recording many notable steps of progress in the engineering arts and industrial research during the next twelve months in this REVIEW.