given train could be cut in half, or even reduced 25 per cent of its present amount? Might not a new type of car bearing be developed that would accomplish this without materially increasing the financial hazard of wrecks due to journal troubles? Or again since the present type of locomotive has about reached its maximum development in respect to size and economy, is it possible to evolve any other type that would be more desirable and satisfactory?

In order to stimulate the inventive thought of its employees and keep them actively alert for the betterment of this work it would be merely good business policy financially to reward those responsible for accepted improvements by a certain percentage of the savings effected during some period of time such as say ten years.

What do your readers think about this suggestion?

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Effects of Electric Power Used for Traction

SEATTLE, Wash.

TO THE EDITOR:

In the March 18, 1922, issue of the *Railway Age* there appears on page 727 an article entitled, "Effects of Electric Power Used for Traction" which deals with the question of inductive inteference and electrolysis as related to railroad electrification. Various references were made in this article to the electrification of the Chicago, Milwaukee & St. Paul, and we feel it necessary, in order that there may be no misconceptions regarding the conditions actually experienced on this electrification with respect to the features discussed in the article, that the following statement be made; this as such alone and without reference to any question of the relative merits or demerits of the different systems of electrification.

The C. M. & St. P. has approximately 650 miles of main line electrification. This includes 550 miles of three-phase, sixty-cycle, 100,000-volt transmission line, which for the greater part of its length is located on the railroad right-of-way, in general about 100 ft. in width, opposite the pole line supporting the railway company's telegraph, telephone and secondary signal circuits. The latter are of the usual open wire construction and, of course, extend the full length of the railway, including the electrified zone. Between the telegraph, telephone and signal lines and the transmission line is the 3,000-volt direct current trolley system, on the poles supporting which are located 3,000-volt trolley feeders, a 4,400-volt single-phase, 60-cycle primary signal supply circuit, and the power indicating and limiting circuit. The latter is operated at 1,200 volts d.c. on the Rocky Mountain and Missoula divisions, and at about 3,000 volts alternating current on the Coast division, the current in both cases being very small.

The telephone and telegraph lines consist of metallic dispatcher's telephone and block circuits and the usual grounded railway telegraph circuits. The dispatcher's telephone circuit is regularly used for all train movements, the dispatcher's office on the Rocky Mountain and Missoula divisions being located at Deer Lodge, 226 miles from the eastern end of the electrification and 211 miles from the western end of the electrification. Before electrification the dispatcher's offices were located at about the middle points of the respective divisions and the length of railway controlled by one set of dispatchers was only about one-half the present length. On the Coast division the dispatcher's office is located at the extreme west end of the 209 miles of electrified line. Train orders are given over these dispatcher circuits the full length of the line. The dispatcher's circuit is transposed at intervals of about 900 ft., and telegraph and telephone wires where they enter stations are fused and provided with simple standard protectors.

Electrical operation began on the Rocky Mountain division in December, 1915. At that time the feeders extending east and west from the respective substations, instead of being tapped directly at the latter to the trolley, were tapped a mile away from the substation so as to interpose a resistance which would diminish the liability of flash-over of substation motor-generator sets in case of short-circuit on the trolley. This arrangement existed pending the final development and manufacture of the so-called high speed circuit breakers which, during the year 1917, were installed in the various substations in the negative connection to the rail. The function of these breakers is, in case of short-circuit, to very rapidly interpose a small ohmic resistance in the trolley circuit, limiting the magnitude and duration of the short-circuit current to a value which will not cause flash-over of the generators and which can readily be handled by the regular feeder breaker.

Previous to the installation of these circuit breakers, flash-overs of the generators were of comparatively frequent occurrence. These resulted in very little if any damage to the generator, but at times produced a rather severe acoustic shock to those using the dispatcher's telephone circuit, so that a few of the telephones connected thereto were provided with a megaphone horn connected directly to the original receiver. No loud-speaking telephones have ever been installed on the electrified zone on account of inductive interference as stated in the article. The installation of the high speed circuit breakers, though not primarily installed for this purpose, resulted in the elimination of this trouble.

Any effects due to short-circuits on the 100,000-volt transmission system, which are of infrequent occurrence, have, as far as acoustic disturbances are concerned, been reduced to a point where they are considered negligible, largely as the secondary result of the installation of an improved relay system for high tension line, which provides a satisfactory selective action with respect to the rapid and positive isolation of the particular portion of line in trouble. Depending on the severity and location of the short-circuit, the fuses in the telegraph and telephone wires, as referred to above, will or will not blow, but they are found thoroughly to protect the apparatus.

The article in question also states that the noise conditions were such under normal operation as to require changes in the generator construction and the installation of resonant shunts. Under normal operation there has never been interference with the telegraph and telephone circuits of any magnitude sufficient to interfere with the operation of either the telegraph or telephone circuits. Under emergency conditions, such as those above referred to, the means described have taken care of the noise conditions by doing away with the acoustic shock and the undesired operation of the protective apparatus. No changes have ever been made in the generator construction, nor have such changes been considered or contemplated.

With respect to the installation of resonant shunts referred to in the article, three such shunts were installed in the substations on the Rocky Mountain and Missoula divisions at the instance of one of the telephone and telegraph companies, which found by tests the existence in some of their circuits of a harmonic of frequency corresponding to the tooth frequency of certain of the railway company's motor-generator sets supplying the trolley system. The shunts were found practically to eliminate this harmonic from the trolley circuit, and though those in charge of the railway telegraph and telephone circuits felt that the effect of the shunts in the operation of their own circuits was inappreciable, the railway company, in its desire to exercise such co-operation as it deemed reasonable and proper, and to take advantage where warranted of any means of possible improvement, per-

mitted the installation of these shunts and included them in the contracts for apparatus specifications for subsequent electrification of the Coast division. The request with respect to the installation of the shunts on the Rocky Mountain and Missoula divisions applies to those three of the 14 substations in which 1,500 kw. units were installed. In the case of certain of the 2,000 kw. sets of the other stations, the suggestion was made that the already comparatively minor effect of any harmonic due to these sets could be reduced to the very favorable average of the other sets by the simple expedient of shifting the generator couplings so as to secure the best relative position of the two respective generator armatures.

The article states that 60-cycle transmission lines, used in connection with the power supply to direct current trolley systems, give rise to inductive interference which is greater than that caused by transmission lines of 25 cycles serving the alternating current systems. Under exactly the same conditions, a 60-cycle, three-phase transmission line would, naturally, produce greater disturbance than a 25-cycle, three-phase line, but the actual facts with respect to the C. M. & St. P. are that inductive effects under normal operation are not such as to affect the practical operation of the telegraph and telephone circuits. In fact, when different sections of the transmission line were placed in operation, some of these sections being 100 or 200 miles in length, those listening in on the dispatcher's telephone circuit at the time were unable to tell when the current was switched on and off the line.

The writer of the article makes the statement that the conditions on the Chicago, Milwaukee & St. Paul are not comparable with those, for instance, on the New York, New Haven & Hartford electrification, but in what respect this is the case is not stated in sufficient detail to enable a definite idea of the conditions to be derived, either as to length, proximity, etc., of exposed circuits or the effect of conditions of traffic. It is not clear how the fact that fewer trains are run on the C. M. & St. P. than on the New Haven necessarily affects the question.

The simplicity of the interference problem in connection with the C. M. & St. P. electrification, both as regards the conditions to be met and their solution, is one upon which many visitors to our electrification have particularly and enthusiastically commented, both during their visits and in such subsequent reports as we have noted. In this connection it may be permissible for me to refer, as has been done before by others, to the following extract from a report prepared by the French commission which was sent to America in 1919 to study the principal electrified systems in this country:

"A considerable advantage of the direct current system is that it does not seem to have any but the slightest interference with the telegraph and telephone lines—in fact insignificant. We are well able to report that one may telephone very easily on the various lines of the railroad placed all along the tracks on an aerial wire without any protection.

"A multiplex printing apparatus for the telegraph service worked between Spokane and Helena with an earth return, was diverted especially for us in such a fashion as to use a wire placed on the poles of the electric railroad for a distance of 270 kilos. This operated perfectly during eight days without even being troubled by three short-circuits made very complete intentionally between the trolley wire and the rail in the course of the telegraph wire."

With respect to electrolysis, this is recognized to be a question which in the case of the d.c. system should receive careful consideration. Its practical importance, as determined on basis of the protective measures necessary, will depend on the circumstances surrounding the individual case.

In the case of the C. M. & St. P. electrification, the cases of electrolysis which have arisen have been of comparatively minor importance and have required only simple and inexpensive means of correction. For instance, regarding the substation piping, particularly referred to in the article, it was found about one year after commencement of electrical operation, that at a few of the substations a small water pipe running parallel to the tracks between the substation building and the operators' bungalows was being attacked by electrolysis. As a result of tests, a copper leakage cable was installed and bonded to the pipe and the track rail, which construction was made standard at all stations. The small amount of pipe which had been severely attacked at three or four stations was removed and replaced by new pipe, with the result that it has been unnecessary to replace any pipe during the five years of service which has since elapsed.

R. BEEUWKES,
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The Future of the Steam Locomotive

NEW YORK.

TO THE EDITOR:

The communication by Frederick A. Delano, which appears on page 1,004 of the *Railway Age* of April 29, presents some tremendously important subjects which railroad officials will think about most carefully. Coming from him, every railroad official will take these suggestions most seriously.

In connection with the steam locomotive, however, such remarkable improvements are available, exactly to meet the requirements of the times, as to justify the suggestion that before going to electrification or to other forms of motive power, the steam locomotive should be developed to its logical limits. Being a rather close observer of locomotive progress, the subscriber holds the conviction that the steam locomotive has never yet been brought to anywhere near its logical limits.

To accomplish this, it is necessary to know what has happened to the steam locomotive during the past few years, to make use of the opportunities available for its improvement and to ask the operating officials to use the new locomotive to the best advantage as manufacturing managers use their expensive machinery.

This is simple enough when locomotive improvements are thoroughly understood. It is most important to recognize the fact that the steam locomotive can be made to be something that it has never been before and that it can be made to do things which it has never been made to do. When this fact is accepted we shall see instantly that the steam locomotive has not yet even approached the limit of its capacity, efficiency and economy.

No one can be in better position than is Mr. Delano to realize and point out the necessity for locomotive improvement. The object of these paragraphs is to show that we have overlooked factors in the steam locomotive problem which will answer the criticisms made of it. It is my belief that several efforts which are now being made in the improvement of both boiler and machinery of steam locomotives on a number of the most progressive railroads will in a short time answer the criticisms and lead to the attainment of the specifications briefly outlined by him. G. M. BASFORD.

Red Tail Lights on Automobiles

CHICAGO.

TO THE EDITOR:

Referring to the editorial in the *Railway Age* of January 14, page 166, and to the letter to the editor by "P.S.C." in your issue of February 11, page 362, relative to the use of red tail lights on automobiles: Many things have been accomplished that seemed to have less likelihood of success than has the substitution of another color for red on the rear of automobiles. The cost per machine is not more than 35 cents to an automobile driver who will do the work him-