

by the committee, and consider that one card would lead to errors in classifying cars.

Summing up the answers, therefore, it will be seen that your committee has failed to secure a unanimous approval of the inspection card recommended. While the majority of the roads agree to the arrangement of the card, and the plan covering its use as suggested, others think that better results can be obtained by using separate cards for each classification; either printing on the card the commodity to be handled, or by using cards of different colors.

The main objection raised against a single card for the three classifications is on account of requiring the inspector to write the letter A, B or C, indicating the classification; and there is still another objection raised, as it contemplates requiring the switchmen or trainmen to read the card and ascertain from the information written thereon the class of commodity the car is suitable for handling.

Your committee, endeavoring to make a complete review of the possibilities of determining what would seem to be required in the way of an inspection of equipment satisfactory for most of the commodities offered for shipment which might be readily

damaged by moisture, found that a schedule for such an inspection was feasible, as has been shown in the report, and that the requirements can be made to very readily fit in with whatever final form and plan of handling the card is adopted; but has not been so successful in working out a card satisfactory to all railways.

The use of colored cards would seem to be perfectly practicable, and would not necessarily disturb the fundamental inspection plan proposed, provided it would be considered better to relieve the inspection force from writing the classification A, B and C on the card (which as a matter of fact is practically nothing); and requiring as a substitute the carrying of a larger number of cards so as to designate the classification by color.

It would seem to your committee that even such an arrangement could be worked out and still obtain a uniform practice; but it is the opinion of your committee that since it has gone about as far as it can in the consideration of this subject from a mechanical point of view, it would suggest that the subject be referred to the American Railway Association, or that a committee be instructed to handle it in conjunction with that Association.

## Individual Paper on Maintenance of Electrical Equipment.

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It is the intention not to stray into the pastures of the electrical engineer or indulge in speculations as to the advisability of electrifying steam railways or attempt arguments in defence of any particular system, single phase, three phase or direct current. Such discussions have already been vigorously carried on, with more or less success and satisfaction, by those much better equipped for such contests than the writer. As a result, noncombatants have reached the practically unanimous conclusion that "Time alone will settle the case."

We all recognize the fact that several important steam railways have, to a limited extent, replaced steam locomotives with electric locomotives and multiple unit cars; and that their successful operation for five or six years and the experience gained during this time makes the subject of the maintenance of electric equipment a live one. The fact that at least six American steam railways are now using electricity for motive power purposes and the recent announcements of plans for extensive electrification of main lines on western steam railways suggests the thought that almost any steam motive power organization may be called upon at an early date to maintain electric motive power and should make this subject of interest to all steam motive power men.

The word electricity naturally raises in the mind of a steam motive power man a suggestion of mystery, something he knows little or nothing about, and, what is worse, he is very apt to conclude he is "too old to learn." It is the object of this paper to try to show there is no more mystery about electricity than about water, steam, coal or other gifts of nature about which motive power men have enough knowledge and familiarity to successfully manage their work; if possible, to remove the natural, but useless, fear of the subject which most of us have.

Until about seven years ago, I had no practical knowledge of electricity or experience with electrical apparatus, having held the positions of engineer of tests, division master mechanic, superintendent of

shops and assistant superintendent of motive power with steam railways. This statement is made for the purpose of showing that the point of view of the paper is that of a steam motive power man and with the hope it will make what follows more convincing than otherwise would be the case.

When asked to take the position of superintendent of electric equipment, my first and very strong impulse was to decline because of lack of electrical experience, nor did the statement that all the expert electrical talent necessary would be supplied entirely remove the dread of entering the—to me—mysterious and untried field of electric traction. The assurance of the head of the railway department of an important manufacturer of electrical apparatus that at least 75% of the necessary training was supplied by experience in mechanical lines, did little more than somewhat reduce the distrust and the feeling that the field of electric traction was full of pitfalls and blind alleys. The experience of a few years has shown that the electrical expert was conservative and that at least 90% of the problems of maintenance to be solved and the faults to be remedied can be successfully worked out by a good mechanic, with a very limited electrical knowledge, who has had experience in the motive power department of steam railways.

To those acquainted with the men who are responsible for the maintenance of electric equipment—whether on trolley, interurban or steam railway lines—it is a matter of common knowledge that those master mechanics, general foremen and mechanics who have been trained in the motive power departments of steam railways have somewhat the advantage of those who have not. I have in mind a western mechanic and general foreman whose experience with electric equipment was limited to six months as electric inspectors' helpers, who are eminently successful in maintaining electric equipment. In the case of steam railways which are electrified, there are decided advantages in using men already in the organization, whose charac-

teristics are known, who are familiar with steam railway policy, methods and requirements and such a plan removes all ground for the possible feeling that electrification will crowd out of their positions men who have served the railway faithfully and satisfactorily for years. Some knowledge of electricity for such men is certainly necessary, but is very elementary and simple, preferably practical rather than theoretical, and can be acquired in such a short time that the advantages of using men for the maintenance of electric equipment who are already in the steam motive power department very decidedly outweigh the disadvantages due to lack of an extended knowledge of electrical apparatus. This conclusion has been reached after six years experience in an electric equipment maintenance department on a steam railway.

I am inclined to believe the greatest bugaboo for the steam motive power man, when considering electrical matters, is the fact that he is not familiar with electrical terms and therefore imagines the whole subject is difficult. When the uninitiated hears or reads of volts, amperes, watts and kilowatts, circuit breakers, contactors and other electrical terms, he finds these words as meaningless as so much Choctaw. As a consequence, he gets no real information or adequate conception of the subject discussed and, perhaps naturally, concludes it must be beyond his powers and altogether mysterious. A little reflection will show him that at one time he was equally ignorant about such common place matters as hydrostatic pressure, steam consumption, horse power, air brakes and superheaters, and that in all probability it would puzzle him, after years of practical use, to accurately define these terms, or even explain to a visitor from Mars what a foot really is, though for all practical purposes he knows each of them thoroughly and never imagines his inability to define technically the words he uses almost hourly is any handicap in successfully holding his job.

The volt is defined as "the practical unit of electromotive force which will cause unit current to be established in a circuit of unit resistance," but for all practical purposes may be considered as the unit for expressing the pressure or tension of an electric current, just as the pound is the unit used in expressing boiler pressure.

There is no doubt arising in the mind of anyone as to the meaning of the sentence, "the boiler carries a pressure of 100 lbs." nor is it necessary to be precise and add, "per square inch," because constant use has made us familiar with the meaning of the statement without looking in a book or stopping to think. We know that, other conditions remaining constant, steam at a pressure of 200 lbs. will do twice the work that steam at 100 lbs. pressure will. In the same way, a little practice will enable us to understand off-hand there is twice the power in a 200 volt current there is in a 100 volt current, because the former has twice the electric pressure of the latter. When we become familiar with the fact that the usual voltage of the electricity used about the home for lighting purposes is 110 and that the usual voltage for trolley and interurban, as well as multiple unit, electric cars, varies from 500 to 600, we have a working basis from which to understand the statement that a transmission is designed for 11,000 volts and a very large part of the wonder and mystery disappears.

With the above statements thoroughly fixed in our minds by constant use, if we read that the Chicago, Milwaukee & Puget Sound Ry. is planning to electrify several hundred miles of its lines, using a voltage