

DISCUSSION ON HIGH-TENSION TRANSMISSION REPORT.

J. H. FINNEY: Is not the spacing between wires given in Class E, in error? In the other classes the spacing seems to increase in direct ratio, but in Class E, for 31 300 volts, the spacing is only 31 inches. Is not this a mistake?

RALPH D. MERSHON: The figures were examined carefully so as to prevent mistakes. There are not very many plants in this class, only four; so it depended on the choice of only four men to decide the average.

PETER JUNKERSFELD: Answer 5, Class A, on page 576 of the Committee's Report refers to the use of a ground-net of 0.25 inch steel cable suspended across the right of way and under power wires. This is of interest as it has been proposed by the Underwriters for insertion in the National Electric Code. It would be interesting to know the extent to which such ground-nets have been used and what degree of protection can safely be credited to them.

PRESIDENT ARNOLD: These nets are installed under high-pressure transmission lines in a number of places between Chicago and New York on lines paralleling the Lake Shore and the New York Central railroads, also between Chicago and Denver. They are in much more common use in Europe. We have just begun to use them; as a particular instance they may be found on the line of the Fonda, Johnstown, & Gloversville Railway.

L. SCHULER: Ground-nets are used in Europe to a great extent, especially in Germany and Switzerland, as the authorities require them for a high-pressure line crossing a highway. It has been found, however, by experiment that in nearly all cases the wire, if broken, will, in consequence of its twist, jump over the side of the net. If a high-pressure line crosses a railroad, the authorities usually require a completely closed tunnel of iron work through which the line passes.

RALPH D. MERSHON: The speaker has put in one or two of these ground-nets himself, but he does not think very much of them. They are generally put up as a matter of sentiment, as a protection in the event of lines coming down, especially from sleet. If it is feared that the lines will come down from sleet, then of course the netting has to be strong enough to carry any sleet that might collect on it. A netting could be put in strong enough to take care of any probable load of ice or snow, but that would mean a rather formidable sort of structure. Probably the best method of protecting lines liable to be crossed by high-pressure wires is, if possible, to put the poles of the crossing line on each side of the line crossed; have these poles close together, and so high that if the upper line breaks it cannot possibly reach the line crossed. Such construction is as near absolute protection to the lower line as you can get against anything short of the main line falling down sideways.

S. B. STORER: The Utica and Mohawk Valley Railroad Company have a short section of their line fitted with the netting underneath. This netting is made of two iron wires on either side of the cross-arm; these wires are twisted and at intervals of about six feet there are three-cornered sticks from one side to the other that are expected to hold the transmission line in case it breaks. The iron wires supporting these sticks are mounted on insulators of exactly the same type as used on the transmission line, so that even if one of the two transmission wires should break there is no tendency for it to ground. The speaker does not like this kind of construction, because he thinks the netting or cradle suspension should be permanently grounded. An iron cross-piece is preferable to a wooden cross-piece for the reason that in using synchronous motors or synchronous converters, one line might break and the two ends drop on this netting, and the machines would go on operating just as they were before. If this did happen, and the wooden cross-pieces were wet, they would carry the current to the iron span-wire thus completing the circuit through the cross-pieces and the iron wire. This would quickly burn the cross-pieces and the wires would drop down just the same as if no support were there. Perhaps it would be much better to have a strong iron netting underneath the transmission line and have the wires of such capacity as to carry a short circuit without burning off.

F. A. C. PERRINE: At the National Electric Code meeting last year this subject was carefully discussed. The Underwriters were at first very strongly in favor of a netting, but the question just asked by Mr. Storer, whether the netting should or should not be grounded in any case, came up at once. It seems important that the netting should have at least as great carrying capacity as the transmission wire itself, otherwise the netting would burn off by reason of the wire grounding.

The second plan proposed by the Underwriters was the one mentioned by Mr. Mershon, that of setting the poles close enough together and elevating them to such a height that a break in the wire could not bring the transmission line in contact with any wire crossing underneath it.

There were, if the speaker remembers correctly, three methods accepted by the Underwriters: first, guard wires placed on the ends of the cross-arm carrying the telephone wires and above them so that the transmission line could not come in contact with the telephone line by breaking. This was the preferred method, and it was left to the discretion of the transmission company whether it would ground or insulate the guard-wires, it being considered that it would make very little difference which was done. The grounding of it would have a tendency to burn off the transmission line, but in either case the transmission line could not come in contact with the telegraph

or telephone wires. The other two methods were admitted as permissive. In the second method the transmission line would have to be raised the height of the street above the telegraph and telephone lines, so that in case of a break it would fall out of contact, which means that in a 60-foot street the transmission line would have to be 60 feet above the telegraph and telephone lines. The third method was the use of a grounded screen. In that case the screen should have more carrying capacity than the transmission line itself, so that in no case would the screen be burned through. All of these systems were recognized as being deficient, but after discussion lasting one day in which the National Electric Light Association, the Pacific Coast Transmission Committee, the INSTITUTE, and the Underwriters were involved, that was the best that could be gotten out of it.

The importance of this is very great, for there has been at least one instance of a transmission line falling across a long-distance telephone line and burning out all the instruments within many miles, and burning down a house. But it is questionable whether these guard-wires are sufficient protection. The speaker thinks there is not yet any very well-established experience.

EUGENE CLARK: Dr. Perrine has not mentioned one serious fault of any form of netting: the transmission span would generally be from 100 to 300 feet long at a crossing, and the netting under the line would necessarily be only a few feet wide. Under such conditions, a broken transmission line would probably curl up and fall off from the netting. Under such conditions, the netting would be useless unless thoroughly grounded.

S. B. STORER: The speaker understands that in Switzerland they make use of a ring projecting from the cross-arm through which each transmission wire passes; these rings are on both sides of the insulator so that if the wire breaks it will strike the ring before the ends touch the ground. These rings are grounded. Has any one here seen that construction, and does it afford protection?

W. B. JACKSON: It is used upon the Valtellina Road in Italy, where the high-pressure wires are equipped in this manner at each road crossing. Although the rings operate very satisfactorily in case of a break in the line, they sometimes give trouble when the lines do not break, and the engineers consequently found it desirable to have them cut out.

PRESIDENT ARNOLD: Why should the ring operate without the wire breaking?

W. B. JACKSON: They found that to give a sure grounding when the line broke they had to make the ring quite small or had to carry it a considerable distance out from the cross-arm, otherwise the wire might drop and not ground; but if they got it too small or too great a distance from the cross-arm there was danger of its becoming slightly displaced and thus causing a ground when such was not desired.

N. J. NEALL: On page 594, rubber insulation is said to deteriorate in a short time. What is the relative depreciation in rubber cable?

JAMES LYMAN: Several cases have come to the speaker's notice of lead-covered, rubber-insulated, single-conductor cable, used for station wiring, where the rubber has deteriorated very rapidly, and broken down after only a few months' service. It is probable that in these cases a high static pressure was induced. The rubber seemed to be cut, and acted upon as if ozone had been present. In one case the cable was used on 13 200 volts pressure, 25 cycles; it was made to stand a working pressure of 30 000 volts, and breakdown pressure of 50 000 volts. After operation of about two months it went to pieces at different times, under normal operating conditions. There was no question regarding the good quality of the rubber insulation. There were six of eight different breakdowns at different times, thus indicating that they were not due to any defect in the cable itself. Another case came to the speaker's knowledge of a single, lead-covered, rubber-insulated cable, used on 13 200-volt, 60-cycle current, good for perhaps 20 000 volts—that broke down in the same way. For these reasons the speaker does not recommend the use of single-conductor, lead-covered cable, either on 25- or 60-cycle work, for station or outside wiring, where the pressure is above 5000 or 6000 volts; below that there is not much danger of the static discharge. The speaker knows of a number of cases where single-conductor, lead-covered cable is used on 6000 volts, and no trouble has been experienced.
