road. The anchor cables were then laid out, measured, and cut, and their bridge sockets attached.

The three lines were erected one at a time, the middle line first and then the downstream and the upstream lines in succession. The ends of the anchor cables were hoisted over the towers, the south shore cables made fast to the centre span cable, drawn over the tower until the bridge sockets touched the main sheave, tied to the top of the tower and attached to the anchor pier. The north shore cables were next attached to the centre cable, the suspension insulators and copper line fastened to this and the cable hoisted into place.

The proper location of the suspension insulators was determined beforehand for both the steel and copper lines, due allowance being made for stretch in the cables, and these distances were chained off on the cables as they lay on the ice. After the cables had been hoisted into place the end spans of the copper lines were attached to strain insulators on the towers and drawn up until the suspension insulators hung vertically.

A Construction Problem

The hoisting was done by a steam hoist braced against the centre anchor pier on the north shore. Two ⅝″ steel hoisting lines, reeved through two pairs of 3-sheaved blocks, were used to draw the end of the cable up to within 40 ft. of the anchor pier, the final 40 feet being taken up by means of two ¾″ steel cables reeved through two pairs of six sheave blocks.

The method of pulling up the cables appealed to us as being quite simple and easy of accomplishment. However, we found that it was a nerve-racking process the first time we tried it. The cable seemed to come up easily to within a short distance of the anchor pier, when the hoisting engine began to show signs of distress. When the end of the cable was within 3 ft. of the anchor pier the hoist suddenly coughed and quit.

Those of us who had calculated the length of the cable and measured it as it lay stretched out on the ice, wondered if we had slipped up on our figures or our measurements; for, at the calculated tension in the cable, allowing generously for friction in the blocks, the hoist should have been capable of pulling the cable right home through twelve parts of line without any trouble. The riggers didn't believe that we were able to calculate the tension and were wondering if their pins and lashings would hold.

A wait of ten minutes for the hoist to recuperate and for an inspection of the tackle and connections, a little sand in the clutch, a few more revolutions of the drum, and the cable came in another foot.

Another ten minutes for inspection and recuperation, another puff or two, a few more inches gained and finally, by dint of nursing the hoist and pulling for it on the part of all concerned, the cable was hooked up and made fast.

A slight change in the tackle made it possible to pull up the other two lines without any mental effort whatever.

The copper conductor in each line is supported by 17 suspension insulators spaced about 250 feet apart, the end insulators being about 400 feet from the towers. The copper lines drop from the end insulators to strain insulators on the towers at the 150 ft. level, pass through the towers to the back, where they are connected to another set of strain insulators.

On the north shore the lines pass directly from the main tower to a transmission line tower on the shore a distance of about 600 feet. On the south shore a light structural steel truss, 50 ft. long, hung from two sets of the anchor cables, provides an intermediate point of suspension, forming two spans of 500 ft. each. Access to the insulators attached to the truss is provided by a foot bridge running up from the anchor pier and suspended from the anchor cables.

After the cables were erected, we noticed an almost constant vibration in them, varying in intensity and somewhat similar to that in a violin string, with definite nodes 12 to 15 ft. apart as nearly as could be judged. About a month after the line was put in service, this vibration shook loose the bolts connecting two of the suspension insulators to the cable and they dropped and hung suspended on the copper line.

This condition brought us face to face with a problem which we had considered with misgiving and which had led us to discard the idea of suspended conductors when the crossing first came up for consideration. However, the difficulty was solved for us by two of our riggers who volunteered to go out on the steel cable, for a consideration, and to fish up and re-attach the insulators.

A trolley was devised and constructed of two sheaves on which a small platform was hung and they had little difficulty in getting out to the point from which the insulators had fallen, about 1,000 feet from the tower. By means of a small tackle line, they hauled the insulators back into place and started back towards the tower.

Unfortunately the sheaves on the trolley jammed and they could not pull themselves up. At this point one of the riggers lost his nerve and the episode might have had a tragic ending but for the fact that the other kept his head. He lowered his mate to a boat waiting in the river 250 ft. below, then lowered the trolley, and finally passed the line over the steel cable, slid down to the boat and pulled the line down after him.

A short time later an insulator on one of the other lines broke loose and it was similarly reconnected. This time, however, we profited by our former experience and provided a tail line by means of which the riggers were pulled back to the tower. Since then we have experienced no trouble from this source.

Clearance

So far as we have been able to judge, the suspension insulators had not been damaged in any way by the vibration in the line, but there is a possibility that it may cause the cement in which the caps and bolts are set to disintegrate. We are at present carrying on investigations with the object of devising some means of absorbing this vibration between the steel cables and the insulators.

The cables as originally strung allowed the following clearances between the copper conductors and the average water level during the season of navigation:—

Downstream, 172.5 ft.; centre, 178.8 ft.; upstream, 180.6 ft.

The temperature at the time of erection was about 20° F. As there is a change in sag of approximately 1 foot for each 10° change in temperature, the above would correspond roughly to clearances at 110° F. of 163.5, 169.8, and 171.6 feet respectively.

At the time these cables were erected, we naturally expected the sag to increase as the cables stretched under the load until the strands were drawn tightly together. There was no data available with regard to the amount of stretch to be expected, so that it was impossible to allow for this in sagging the cables. The hoist, therefore, was left in position so that we could pull up the cables when the sag became too great.

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