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NOTES ON THE PERFORMANCE OF
HOISTING ROPES*

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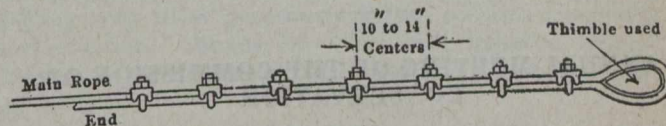
THE ropes used were $1\frac{1}{8}$ ins. diameter, plow steel, 6 by 19 regular lay and 6 by 7 long lay. They support a skip weighing empty about $2\frac{3}{4}$ tons, with an average ore load of about 6 tons and average weight of "rope out" of about 1,000 ft. or 1 ton. They are wound over 10-ft. diameter drums and 12-ft. diameter head sheaves, and are supported in the shaft by 9-in. diameter idler pulleys spaced 30 ft. apart on the shaft slope of $47^{\circ} 30'$. Each rope is 2,000 ft. long.

The hoisting ropes are examined each day before regular hoisting starts, and at this time the rope is run very slowly past the inspectors, who look for broken wire or other signs of weakness. A lubricant is used on the rope, but it is such that it does not coat the rope so that the wires cannot be seen. The rope is attached to the bale of the skip with a thimble and clevis, not with a socket. Seven clamps (see Fig.) are used to fasten the rope and these are all so placed on the rope that the U-bolt part of the clamp bears on the turned up end of the rope and the broader piece bears on the main rope.

Tests have indicated that this method of attachment permits the support of a load equal to the ultimate strength of the rope, but when the rope clamps are alternated the rope may fail at 80 per cent. or less of its normal strength because of the concentration of stresses where the U-bolt constricts the standing portion of the rope. Experience with various types of ropes has given results favoring a plow-steel Lang-lay rope of 6 strands and 7 wires per strand for use where the sheave wheels and hoist drums are of sufficient diameter to avoid excessive bending (in this case 12 ft. [3.66 m.] and 10 ft. [3.04 m.]

*Extracted from paper read before the American Institute of Mining Engineers.

respectively), since a greater reduction of diameter by wear may be suffered without fracture of the wires. This wearing service is, of course, more important in a slope shaft than a vertical one. With the regular lay ropes first installed, the type selected had a special arrangement of large wires at the outside of each strand (known as Seale patent lay) and this type of rope gave good service. Ropes with Seale's patent lay of wires have also been tried in the Lang-lay type, but they increased in diameter at various points with a loosening of the outer wires (or



Clamps Arranged so that the Broader Surfaces Bear on the Main Rope, U-Bolts Bearing on Turned-up End

"bird caging") so the stress was carried largely by the few inner wires. This condition was undoubtedly aggravated by the fact that the hoist drums will not hold all the rope in one layer so there is a beating or slapping effect as the second layer is guided over the first layer. "Bird-caging" is also more severe when a swivel attachment of a 6 x 19 Lang-lay rope is made to the bale of the skip because the twists of both the wires in the strands and the strands of the rope are in the same direction of rotation. Therefore, as the rope is stretched the pitch of the strands becomes greater, and the wires in the strands are untwisted a certain amount. The outer wires of the strands are lengthened in this manner disproportionately with the inner wires and "bird-caging" is the result. If there are only seven wires in the strand there is only one layer about the core wire, so the above effect is not produced. With a regular-lay rope a swivel is an advantage as it permits the rope to rotate as its length changes, and, since the wires in the strand are twisted in the "opposite hand" to the twist of the strands of the rope they tend to counter-

Table I.
Period in service.

Type of rope.	Period in service.	Tons ore hoisted.	Foot-tons of work performed.	Re-marks.
6 by 19, Seale patent, ordinary-lay, south rope	April 27, 1910, to Feb. 8, 1912, or 650 days	315,759	471,758,554	A
North rope (above plus)	Nov. 4, 1913, to Sept. 20, 1914, or 320 days	200,864	326,441,347	B
Total north rope	970 days	516,623	798,199,901	
6 by 19, Seale patent, Lang-lay south rope	Feb. 8, 1912, to Nov. 4, 1913, or 634 days	408,867	651,957,881	C
North rope	Feb. 8, 1912, to Sept. 20, 1914, or 954 days	609,732	978,399,228	D
6 by 7, Lang-lay, each rope north and south the same	Sept. 20, 1914, to June 1, 1917, or 983 days, and still in service June 28, 1917	955,470	1,468,287,514	E

Remarks.—Foot-tons of work does not include weight of skip empty and rope when lowering. The above figures should be increased approximately 38 per cent. to cover this item.

A. North and south ropes taken out of service because of the number of places broken wires showed; the maximum number of broken wires within one foot was 12.

B. North rope returned to service as an emergency after Lang-lay 6 x 19 north rope became badly "bird-caged" and had a number of broken wires in one strand ravelling, since breaking tests of sample gave confidence in the rope.

C. Lang-lay south rope removed for reason given in remark "B." It was turned end for end on April 4, 1913.

D. Lang-lay 6 x 19 north rope "bird-caged" considerably after it was in service a short time, but had few breaks of wires until September 20, 1914, when there were possibly 16 breaks in three feet.

E. Lang-lay 6 x 7 north and south ropes were turned end for end on July 6, 1916, as a matter of policy, but show not more than four broken wires each at present, and these are now wrapped on the drum. The north rope has suffered severe stresses twice because of skip derailments during hoisting. They appear in excellent condition.