winding ropes are generally oiled, haulage ropes in many cases are not. We regularly oil our winding ropes once per week with a mixture of tallow, tar and lampblack, rubbing it well in with long-handled brushes, while the rope is slowly lowered out or drawn in. Our haulage ropes are not oiled however, presumably for the reason that running through occasional wet and over dusty roads, although rollers are placed but 20 yards apart, the frequent slack ropes and the rubbing on the rollers would soon take the oil off, and little or no benefit would be derived, while expense would be entailed.

A great point would be gained if some simple oiling arrangement could be brought out for haulage purposes, which should combine a box through which the rope should pass, and which should be filled with a preparation of oil, together with some brushes fixed on the inner side of a revolving screw, to work the oil well in, the frames carrying the brushes being caused to revolve by the rope itself. Some means would be required, such as a pan placed underneath, to catch any oil carried through by the rope in waste, and to prevent the oil running out of the opening in the box left for the rope.

Mr. C. M. Percy describes an arrangement for oiling winding ropes, consisting of a trough formed in two pieces of timber, which loosely clam the rope. The trough is filled with waste soaked in oil, and the rope run through it. This, while a saving in labor, did not effectively oil the rope, and was abandoned.

He also describes a second arrangement for oiling winding ropes, of a pair of friction rollers which grip the rope sufficiently tight to be made to revolve by the rope. These in turn work two brushes, one of which cleans the rope while the other oils it. Whether this is a success or not is not stated.

Some easier method of splicing ropes, too, is badly required. At most collieries it is the rule to put a joint temporarily in a broken rope, and to splice it when the haulage is finished for the day. But many of the smaller collieries have to content themselves with the joints, as there is no one there capable of splicing, the fact apparently being that splicing is difficult to learn, and few trouble to learn it. So that except at large collieries with a number of haulage planes, splices are seldom made, and joints, with their attendant risk of catching against something and drawing out, are the rule.

A frequent cause of broken ropes is the running of the train at unnecessarily high speeds, with the result that the engine has to stand for a time. Knowing what can be wound, is it not wise to arrange a maximum speed or number of journeys per hour, which shall not be exceeded?

Although the amount of slack in a haulage rope is an unimportant matter, provided the engine-man starts his engine quietly and gradually puts the full strain on the rope, which ought always to be done, yet in the case of winding ropes it is most important.

In this case the engine-man cannot so nicely regulate the speed of his engine, as the steam is thrown on all at once to get up full speed as quickly as possible. The effect of this is shown by the following tables of strains published by Messrs. G. Cradock & Co. and Messrs. George Elliott & Co.

FIRST TRIAL.

		Tons.	Cwts.	Qrs.
Empty cage, resting on buntons	Weighed	1	16	0
No. 1, Empty cage, lifted gently	Strain of	1	16	0
No. 2, " with 2½ in. of slack chain	"	2	10	0
No. 3, " " 6 in. "	"	4	0	0
No. 4, " " 12 in. "	"	5	10	0

SECOND TRIAL.

		Tons.	Cwts.	Qrs.
Empty tubs and cage	Weighed	2	17	0
No. 1, Empty tubs and cage lifted gently	Strain of	3	0	0
No. 2, " with 3 in. of slack chain	"	5	0	0
No. 3, " " 6 in. "	"	5	10	0
No. 4, " " 12 in. "	"	7	10	0

THIRD TRIAL.

		Tons.	Cwts.	Qrs.
Cage and full tubs	Weighed	5	1	0
No. 1, cage and full tubs, lifted gently	Strain of	5	3	0
No. 2, " " with 3 in. of slack chain	"	8	10	0
No. 3, " " " 6 in. "	"	10	10	0
No. 4, " " " 9 in. "	"	12	10	0

This, no doubt, is the principal reason why ropes wear at the pick-up, and proves the great importance of reducing the slack in winding ropes to a minimum.

These are a few of the practical difficulties that users of ropes have daily to face, and the author feels that there is room for a really useful discussion on these and other points. It is in this hope that he has ventured to give his views and practice, and he trusts that other members will give theirs.

Haulage Ropes—Method of Calculating Friction.*

Early in 1893 I had occasion to ascertain the working load upon a hauling rope, and experienced considerable difficulty in obtaining a rule or formula applicable to the peculiar arrangement by which the rope worked.

The following are a few of the particulars:—

Average weight of full tub	..	14½ cwts.
No. of tubs in a set	28	....
Total weight of set, 14·5 × 28	.	20 3 tons.
No. of bottom rollers	23	....
Binding sheaves	5	....
Binding down sheaves	2	....
Curve "	10	....
Bell "	1	....

Heaviest gradient 1 in 13·3 for 305 yards.

I had to allow, in the absence of any direct rule, for the friction on the various sheaves and rollers, square turn, and heavy drift, down which the rope worked to reach the bottom seam. This allowance I put down as:—

Full load	406 cwts.
Say $\frac{1}{82}$ for friction	4·95 "
	410·95 "
Say friction on roller sheaves, etc	1·22 "
Total	412·17 "
Heaviest gradient 1 in 13 .... $\frac{1}{13}$ of 412·17 =	31·7 "

* By Mr. C. F. Scott.

Working from these details, and taking the average of three authorities and sundry rope-makers' approximate rules, the working load worked out to 29 cwts. I was not satisfied with these results, and determined to obtain, if possible, some direct information upon the point by asking the question through the columns of the *Practical Engineer*. I was successful, and thinking the information might be useful to other members of this Association, my friend, Mr. F. Eastmead, of 39 Victoria street, Westminster, gave me, most cordially, permission to publish in the Journal the calculations he made for me. I may say here that he had made several experiments to ascertain the friction ropes would have to overcome in travelling round sundry pulleys necessary to work the hydraulic lift in the Blackpool Tower, which he erected.

The following is the paper he so kindly sent me:—

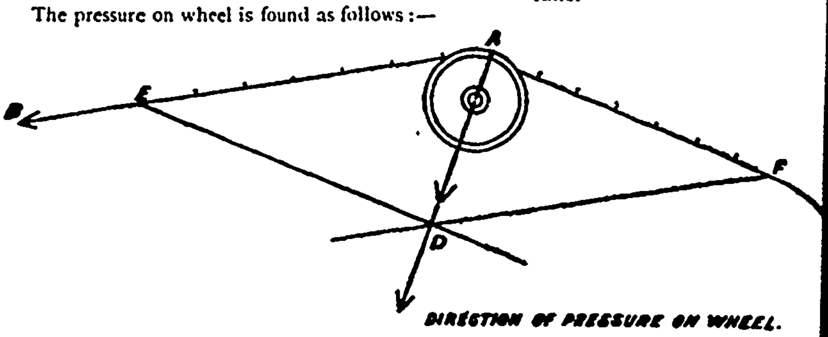
The loss of work due to the friction of the spindle is found by multiplying the pressure on the wheel **P** by the coefficient of friction—**U**.

Thus, loss = **P** × **U**.

The equivalent pull on ropes is found by dividing this by the ratio between the pulley diameter and spindle diameter.

This extra pull on rope due to friction = $\dfrac{P \times U}{\text{ratio.}}$

The pressure on wheel is found as follows:—

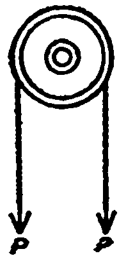


Set out **AB** and **AC** representing the angle made by the rope. Mark off **AE** and **AF** to any scale, say 1-in. = 1 ton, representing the pull on the rope. Draw **FD** parallel to **AE**, and **ED** parallel to **AF**; then **AD** represents to the same scale the pressure on pulley (add to this the weight of wheel itself, when spindle is horizontal).

The loss of work due to bending a rope round a pulley may be taken, if the rope bends half round the pulley, thus:—(see sketch below) to be 15 lbs. for every ton load in each end of the rope; if **P** and **P** be each 1 ton, a weight of 15 lbs. must be added to **P** to make it go round (neglecting spindle friction).

I allow a factor of safety, myself, of 10 to 1 for ropes (direct winding) and make the pulley diameter = 19 times the circumference of rope.

(A) The coefficient of friction **U** is taken as ·15 of the pressure on spindle.



28 coal-tubs at 14·5 cwts. = 406 cwts. =	20·3 tons.
Assumed weight of rope	·4 "
	20·7 "

So, for calculation we shall take pull on rope to be—

$$\frac{20{\cdot}7}{13} = 1{\cdot}59 \text{ tons, or } 3{,}560 \text{ lbs.}$$

(B) We may assume that the rope lies on the 50 bottom rollers with just pressure enough to drive them; in this case there is no loss from bending the rope, but assuming weight of roller to be 56 lbs., we may take the pressure on the spindle to be 60 lbs.

Ratio of roller diameter to spindle diameter $\dfrac{7{\cdot}5}{6} = 1{\cdot}25 : 1$

Extra pull on rope due to friction $= 50\left(\dfrac{60 \times {\cdot}15}{1{\cdot}25}\right) = 360$ lbs.

(H) The 6 drum sheaves have a pressure of, say:—

Pull on rope × ·1 = ·159 tons = 356 lbs.

Ratio of drum diameter to spindle diameter $\dfrac{17}{1{\cdot}75} = 9{\cdot}7 : 1$

Extra pull on rope $= 6\left(\dfrac{356 \times {\cdot}15}{9{\cdot}7}\right) = 33$ lbs.

(I) Upright sheave. Pressure, say = same as **H** = 356 lbs.

Ratio $= \dfrac{8}{1{\cdot}5} = 5{\cdot}33 : 1$

Extra pull on rope $= \dfrac{356 \times {\cdot}15}{5{\cdot}33} = 10$ lbs.

(C) Pressure = say pull on rope × ·27 = 356 × ·27 = 960 lbs.

Ratio $= \dfrac{46}{2{\cdot}5} = 18{\cdot}4 : 1$

Extra pull on rope $= \dfrac{960 \times {\cdot}15}{18{\cdot}4} = 7{\cdot}84$ lbs.

(D) Pressure = 3560 × 1·41 = 5040 lbs.

Ratio $= \dfrac{46}{2{\cdot}5} = 18{\cdot}4 : 1$

Extra pull on rope $= \dfrac{5040 \times {\cdot}15}{18{\cdot}4} = 41$ lbs.

(G) Pressure = same as **D** = 5040 lbs.