Examples of Single Ropeways.

There are a few very good examples of single rope systems in this country—two in Queensland, one in N.S.W., and one in Tasmania. The first three I am well acquainted with, having superintended the construction, as also designing the first two.

The larger of the Queensland Ropeways was constructed for the Irvinebank Mining Co., Irvinebank, and connects one of their tin mines to the works battery, about two miles distant.

Previous to the Ropeway being installed, the cost per ton for landing the ore into battery bins was in the neighbourhood of 8/6, and the handling at the works would easily account for another 6d. By means of the ropeway the cost now works out at about 4½d. per ton, which includes all running costs, also depreciation, etc., on plant. The capacity of this line is some 200 tons per day, and, apart from the actual saving per ton of ore carried, the Company has benefitted by the output being so much in excess to the possible quantity which the drays and horses could convey previous to its installation.

The second ropeway in Queensland was constructed in the same district, the order being placed immediately after the first ropeway had proved its efficiency.

The ropeway recently constructed for the N.S.W. Cement Works at Kandos has a length of 3¼ miles and a present capacity of some 30 tons per hour. It is designed, however, for a capacity of 80 tons per hour, and presents some interesting features.

Directly the loads leave the loading station they have to be carried up the face of a hill some 450 feet high, and rising with an average grade of 1 in 3. At some points grades as steep as 1 in 2.125 had to be negotiated, which fully justifies my earlier claims for this type of ropeway.

Each individual skip carries a weight of 12¾ cwt. net, and is loaded by means of circular cut off chutes. At the unloading end the skips are automatically tipped as they pass over the receiving hopper, thereby cutting out the work of at least one man.

A word here in passing regarding filling of skips. As the efficiency of the ropeway depends greatly on the regularity with which the skips are despatched, an efficient method of loading becomes absolutely essential, and therefore great attention has to be paid to the type of chutes installed for loading.

Unless the chutes are designed to cut off the flow almost instantaneously, uncomfortable, and in some cases dangerous, overloading is the result, to say nothing of troublesome delays in getting a skip off to time.

The Ropeway in Tasmania, to which I referred, was constructed by a Scottish firm for the North Mount Lyell Copper Co., and, I think, has fully justified its installing.

Odd Types of Single Ropeways.

A type of single ropeway usually called the fixed clip line has been designed for small capacities and carrying very light individual loads. In construction it is considerably lighter, and, of course, much cheaper than the regular type. The outstanding feature is in the clip for attaching the carrier to the rope.

As the name fixed clip indicates, this attachment is made to clip to and practically become part of the moving rope.

The generally adopted plan is to encircle the rope with a strap of steel. This strap, by means of a screw attachment, is pulled sufficiently tight to prevent slipping of carrier, no matter how steep gradient of rope may be.

This type of clip could not be used on ropeways where heavy tensions are the rule, as the steel strap cannot stand the strain of constantly passing over the trestle pulleys.

In working a ropeway of this type, the usual method is to start and stop the rope as each bucket arrives at the loading chute. This is seldom a very satisfactory method, and in some instances loading appliances which travel along with the bucket are adopted.

The Jig Back Ropeways, or, as they are usually called in this country, Flying Foxes, might be described as another type. They are not much in use, and are extremely limited in their scope of work. The usual type is simply an endless running rope stretched between two terminals over one span only, to which are attached two skips working to and fro between given points.

Handling of Pit Rubbish.—The disposal of pit and other rubbish about mines has usually been a source of trouble both for available depositing space and cost of handling.

Ropeways have done much to overcome this, two types being in common use. The first and older method is by installing a bi-cable ropeway having very high trestles. See Plate No. 11. The buckets tip out at given points along the line and form a long heap of debris directly under and within a few yards of the level of rope. All the trestle work, of course, is lost by being buried as the dump grows, and this somewhat tells against its general use.

The second and later type is worthy of more notice. With this plant no high trestles are required, and there is no reasonable limit to the height of spoil bank. The single system ropeway is exclusively used for this machine.

A ropeway is constructed over the entire length of available ground with trestles carrying the rope made of low cheap timber frames which can be taken down as the dump grows. Where the dump or spoil heap is intended to commence, a frame is erected which is capable of raising itself as the heap grows, and travelling backwards over the rubbish which it has deposited.

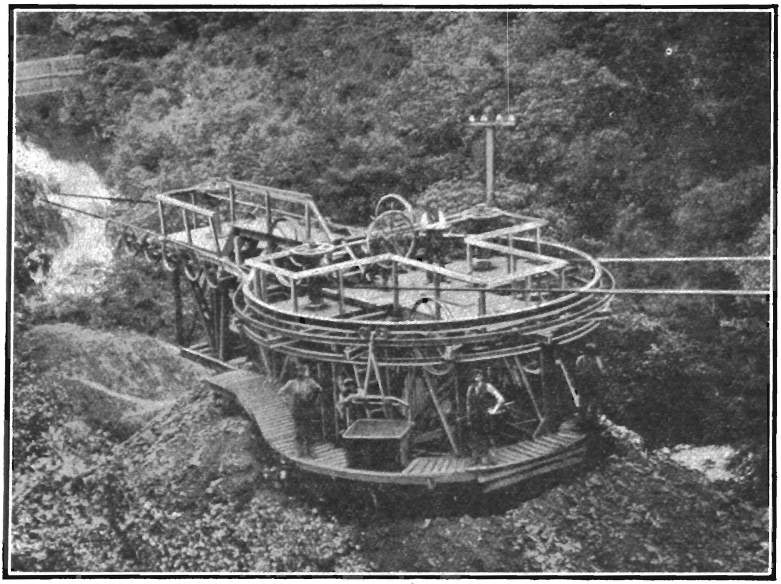

Fig. 8.

Plates Nos. 8 and 9 show one of these ropeways now at work on the Elliote Pits of the Powell Duffryn Steam Coal Co., South Wales. The nominal capacity is 100 tons per hour, but in every-day use it is frequently loaded up to over 140 tons per hour. No coal mines are worked in this country having such a percentage of rubbish, but ropeways of this type would prove most economical, having a much lower capacity than the one under discussion.

Before closing my remarks on the single rope system of ropeways, I may state that ropeways of this type have been constructed in all parts of the world, and under conditions which average engineers would deem impossible. For instance, in the Andes Mountains a ropeway has lately been erected by them having a continuous length of 46 miles, which, I believe, is the longest in the world by about 14 miles. The installation in question is erected for the Dorado Railway Extension Co., and it is being used as a feeder for the main railway, and will be instrumental in opening up a large tract of very rich country situated in the heart of the Andes Mountains. The rope for this length of ropeway is, of course, divided into a number of sections, but the buckets make one continuous run from end to end—that is, one bucket makes a round trip of 92 miles. It is interesting to note that over this entire distance there is practically no wear and tear on the bucket or carrier, as it is carried on a moving rope. Spans of over 1,000 yards had to be negotiated, and the highest point reached on the line is some 11,000 feet above sea level. From these few remarks you will gather that the construction of an ordinary railway would have been very much out of the question, and, in fact, this rich district would have lain dormant probably for all time had it not been for the adaptability of ropeways to this type of country.

The thought has often struck me that similar installations could be adopted in this country with great advantage, especially in the Queensland mountainous districts, where the heavy rainfalls would make intense cultivation possible in some of the higher valleys out of reach of the railway.

Another plant which has been erected in Bolivia crosses mountain ridges over 17,000 feet high, which, I think, constitutes a record in height for this class of engineering.

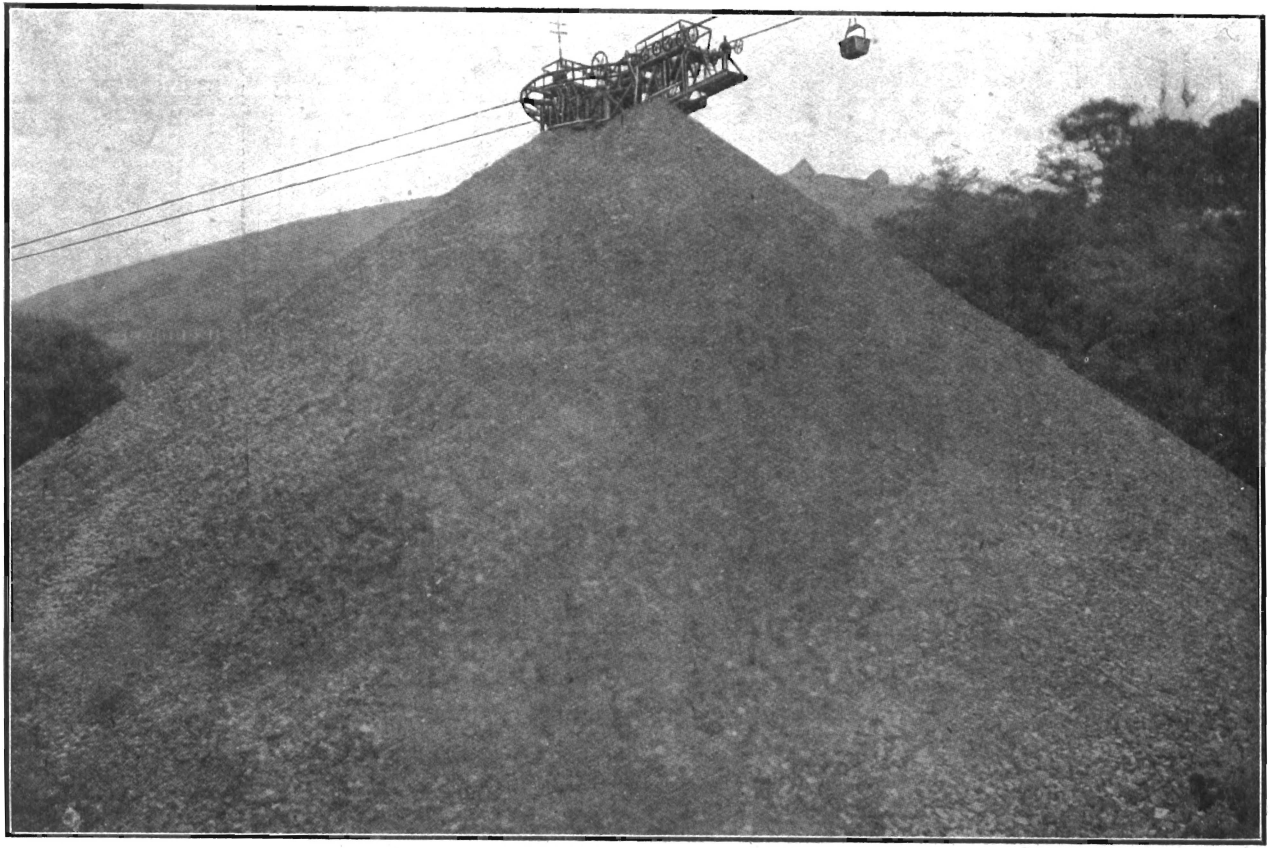

Fig. 9.

As an example of the carrying capacities of the single rope, I might mention a ropeway constructed some five years ago in Morocco, which has a length of about 1½ mile, and a capacity of 150 tons per hour normal. In tests, however, it has carried considerably over 180 tons per hour. The total fall in favour of the load is only some 62 feet, but it is sufficient for automatic working. In fact, a surplus of over 60 horse-power is developed when working at its normal speel. This surplus power is absorbed by means of an automatic hydraulic regulator.

The unloading terminal for this ropeway is somewhat unique. The hopper capacity is for some 25,000 tons, and a special tipping device had to be installed for the purpose of taking advantage of this capacity. The ropes for the hoppers are supported on an overhead gantry something similar to an overhead crane. This gantry travels along the entire length of hoppers, and automatically tips the buckets at any required position.

Bi-Cable or Double Rope Systems.

I do not propose to deal quite so fully with the double rope or bi-cable system, principally because I consider it should only be used in exceptional cases, and in my opinion is not likely to be so universally adopted as its rival system.

In the early part of my paper I compared the two types of ropeways, and will not again discuss the respective merits of the two systems.

In the past many ropeway makers have advocated the double-rope type, not from any necessity of conditions, but because they were unable, by reason of lack of knowledge, to construct a single-rope type of ropeway. This is a fairly broad statement to make, but I have intimate knowledge of these facts. The bi-cable system, that is, where the load is carried on a fixed rail cable and pulled along by a tractor rope, requires less skilled knowledge in the design, and a rougher put up job will work, although far from giving satisfactory results. Speaking fairly, however, if a bi-cable ropeway is well designed and erected with care, it is quite as efficient as the single rope type, so far as actually conveying the material goes, but as regards wear and tear and general upkeep and labour, the single ropeway has proved the most economical. I mentioned previously that one of the disadvantages of the bi-cable system was the excessive wear on the top surface of the supporting rope. This wear is due to the constant passing of the small carriages along the rope. If it were possible to make the wheels of these small carriages fairly large in diameter, the wear would be greatly reduced, but as the carriage has to run round the terminal shunt rails, the wheels are seldom much in excess of 10in. diameter.

One method of reducing this wear to a minimum is by employing a carrying rope constructed on the Lock Coil principle. These ropes have a surface almost as smooth as a round bar of iron, and well constructed carriage wheels bear evenly upon the entire top surface. Consequently, more wires are taking a share of the loads than in the case of a rope of the Langs' lay construction. This can be readily understood, as pulleys, running constantly over the same surface on the Langs' lay rope, would soon cut the individual wires over which they run.

The stations for the bi-cable ropeway are nearly always very complicated structures, as ideal conditions are rarely met with where ropeways are installed. See Plate 10. The ideal conditions would generally be where the lead of the rope entering the stations is almost flat. This, of course, applies also to the single rope type, but to a much less degree.

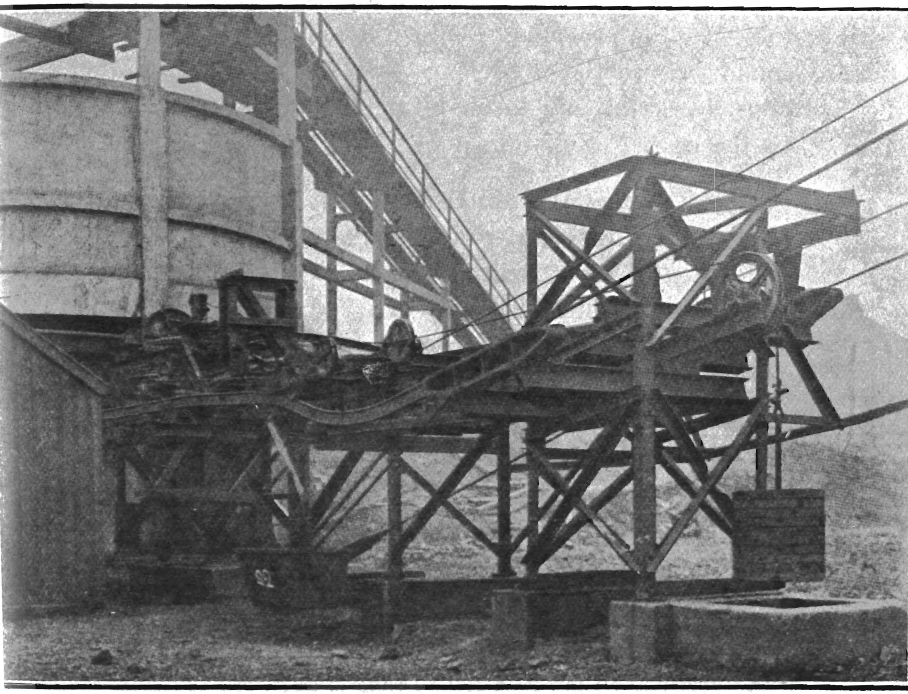

Fig. 10

The main factor in favour of the bi-cable system is the positiveness of its clips, which can be designed to practically surmount any degree of steepness. The clips are made to grip the tractor rope so tight as to, in many cases, distort it. This, on a flexible rope, is not a very serious matter, and, although the life of the tractor rope is greatly reduced thereby, it is comparatively cheap to renew.

Various designs of clips are on the market, some much more efficient than others.

The German firm of Pholig and Bleichert, who have almost exclusively specialised in bi-cable ropeways, obtain the griping action for their clips by using the actual weight of the load, operating through a series of levers to secure the pressume. This principle is not altogether sound, for as the grade increases the pressure on the clips decreases, and in an ideal clip the reverse should be the case.

Messrs. Ropeways, of London, have adopted a clip operated by means of a lever and cam working independently of the weight of load. This gives a positive action, and maintains a grip of even pressure until the rope is released. The aim of this Company has been at all times to simplify the working parts, and I think they have succeeded in this respect.

An interesting bi-cable rope is at present under construction for the Mount Morgan Gold Mining Co. in Queensland, which, when completed, will be one of the heaviest of its type in this country. The reasons for installing a bi-cable ropeway at these mines were extreme steepness of grade, heavy capacity over a short distance, and the necessity to tip at various points between trestles.

In Plate 11 a bucket is seen actually tipping. To make this possible, the main rope must be lowered or pulled down to the lowest point, a loaded bucket would be likely to cause the rope to sag to. Plate 12 shows near view of trestle and bucket.

The frame, or bridle which is attached to the main cable for this purpose, carries a trigger, which operates the trip gear on the bucket.

Generally speaking, the erection of a bi-cable ropeway requires a good deal of skill, and, although greater variation from the design can be permitted than on the

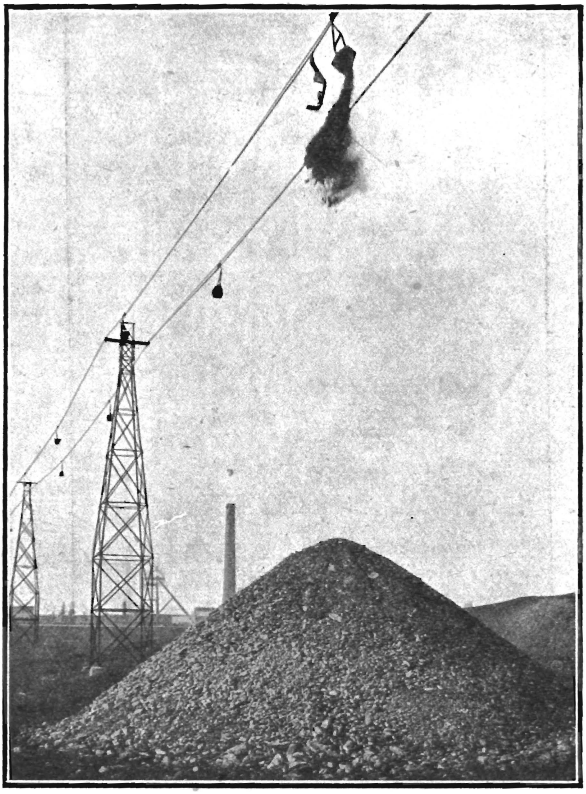

Fig. 11

single rope, still the full efficiency of the machine can only be obtained by paying the greatest care in the layout. For the conveyance of passengers, the bi-cable is invariably installed, principally because the factor of safety demanded on passenger-carrying installations increases the size of ropes to such proportions that they would lack the flexibility to go round any reasonable size of terminal wheel. Also, that by the use of a heavy fixed cable safety devices can be attached to the carriers in case of hauling or tractor rope breaking.

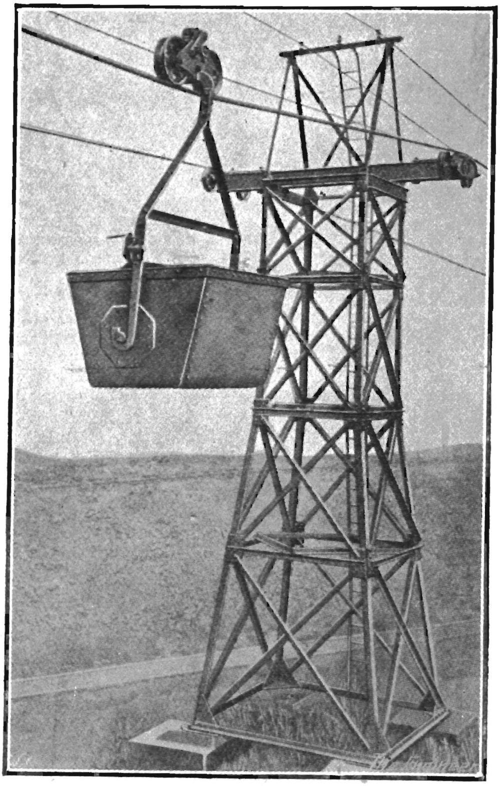

Fig. 12

In the Alps, and other mountainous country where railway construction is practicably impossible, passenger carrying ropeways have been installed, but they are mostly constructed for the purpose of sight-seeing tourists, and built to attract the novelty seekers. They are, however, magnificent installations, and serve to prove what can be done with ropeways.

In concluding my remarks regarding the bi-cable system, I would again state that, for certain conditions, they are the correct type to instal. These conditions are, firstly, where heavy individual loads are to be transported; secondly, where moderately heavy capacity has to be dealt with over a comparatively short distance; and, thirdly, where the angle of rope is greater than one in two with the horizontal. I may add these conditions are frequently met with, and I can assure you they cannot be lightly dealt with, but require the greatest care and skill in designing.

Speed.—Ropeways, both single and bi-cable types, usually work with the buckets travelling at 140 yards per minute. Of course, in exceptional cases this speed has been increased, but for the general handling of buckets at terminals I would not advocate anything in excess of the speed mentioned.

Running Costs.—The cost of operating an aerial ropeway varies considerably with the difference of working conditions, length of line, tonnage carried, etc. But on installations of average length, and designed to carry from 5 to about 100 tons an hour, the inclusive cost of working may be taken as varying from 3d. to ¾d. per ton. These figures cover the cost of labour, stores, power, upkeep, supervision, and general office charges. The upkeep of the ropeway is principally concerned with replacing the worn ropes. This, however, should not represent a formidable cost on a well-designed ropeway. On some lines the ropes, carrying up to 30 tons an hour, have lasted over ten years. On lines having capacities of as much as 70 tons an hour, instances are recorded in which the ropes have carried well over a million tons before requiring to be renewed. These figures apply to the whole length of rope, and not to chosen sections of it. See Plate 13.

Cableways.—Before closing I may be permitted to briefly touch on the third type of rope transporter now in general use. This type is usually called a cableway or