# NOTES ON SELF-ACTING TRAMWAY,

## THE HERCULES MINE, TASMANIA.

*(A paper read before the Sydney University Engineering Society, November 12th, 1902).*

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THE Hercules Mine, situated on the western slope of Mount Hamilton, a spur of Mount Read, is connected with the terminus of the North-East Dundas Railway at Williamsford by means of an inclined self-acting tramway—on the endless rope system. The slope length of this line is eighty and a half chains, and the difference in elevation between the Government line and the "send-off" at the Mine is 1,642 feet. The average gradient is, therefore, 1 in 3·2, the maximum gradient being 1 in 1·5, and the minimum, *i.e.*, the approach to Williamsford terminus, 1 in 8·8.

The permanent way consists of double two feet guage lines of 20lbs. per yard steel rails, spaced seven feet centre to centre of tracks. All joints are made with double fish plates, and the rails are dogged to sleepers spaced at two and a half feet centres. The flanges of rails are notched to take dogs, in order to prevent the down creep of tracks, and at intervals on the steep gradients extra heavy sleepers extend right across both tracks, and are bolted to the rock formation for the same reason.

The Controlling Machinery House is placed above the level of the main surface tramway, which connects with all the underground workings from which ore is at present produced for sales purposes. This allows of the inclined haulage trucks being run underground in rakes and filled direct from the various ore passes. The distance from the "send-off" to the entrance of No. 2 tunnel—the lowest level of the Northern workings—is 9·8 chains, and to the No. 4 tunnel—the most southerly portion of the mine workings—is 21·7 chains.

Storage bins for ore from upper workings and surface benches are also situated upon the main level.

Plate 1 shows formation gradients. All cuttings are in rock, and embankments are formed from the spoil therefrom and rock side-cuttings. The average rainfall of about one hundred inches annually called for ample drainage provision in shape of side ditches and culverts.

The controlling machinery comprises two cast-iron grooved wheels, each fitted with dynamometer brake bands, and the brakes are applied through a lever system, with a worm and hand wheel. The multiplied leverage or pull on brake band is 680 times the pressure imposed at the periphery of the hand wheel, affording in practice a tension of three to four tons upon each brake strap. The front wheel is seven feet in diameter, and has three rope grooves; the back wheel is seven and a half feet diameter, with four grooves. The endless rope is led to the lowest groove of the back wheel, and, after traversing a half-circle, leads direct in turn to the three grooves of the other wheel. The maximum bend in rope is, therefore, half-round a seven feet diameter wheel, and the rope leaves the wheel house from the top groove of the back wheel. (See Figure 3, Plate 2). The two wheels are placed in tandem, and in the same horizontal plane, guide sheaves being used to change the inclined travel of the rope to a horizontal one. (See Figure 2, Plate 2). The brake bands are of five inches by seven-sixteenths of an inch soft steel, having an ultimate tensile strength of twenty-four tons per square inch, and the brake blocks are fifteen by three inches Kauri pine. The grooved wheels are cast in halves and bolted together; they have six-inch diameter shafts of forged steel, case hardened at lower ends, and revolve on cast steel pivots. The bearings are of cast iron, with hard gun-metal bushes. The wooden frame work is built of celery top pine throughout, with the exception of the bed logs, which are of hardwood. These bed logs are set in concrete, and lewis bolted to the rock foundation.

The hauling rope was manufactured by Messrs. Bullivant and Company, England, and is three and a half inches in circumference, and weighs eleven tons. It is a six-strand seven wire Extra Plough Steel Rope, with hemp core, the rope being closed in the same way as the strands are laid, and having an ultimate (tested) tensile strength of forty-two and a half tons. For convenience of handling, it was ordered in three coils each of 3,970 feet in length; three splices were therefore required, and were made each sixty-six feet in length; the tucked ends, measuring five feet six inches, were carefully served with tarred twine to correspond in size with the hemp core which they replaced.

The terminal stations of the haulage line are connected by telephone, and the line is operated by a system of electrical bell signals. At the Williamsford end of the tramway the method of dealing with the working shocks and the slacking or taking up of the endless rope caused by temperature variation, as shown on Figure 2, Plate 2. The rope passes over jockey pulleys, round a seven feet grooved wheel attached to a carriage frame, which traverses an inclined road. To this carriage is fastened an adjustable counterpoise

weight. A breast work of cross timbers is built at lower end of inclined road to safeguard vehicles standing upon the Government line, should by any chance the balance frame become detached.

To reduce friction and minimise wear, the rope is carried over rollers wherever it comes in contact with the formation. Composite rollers, eight inches in diameter, made of Tasmanian Blue Gum, with cast-iron flanged ends and steel spindles, are found to give most satisfactory results, but at places where the rubbing is unusually severe, notably at the thirty-one and a half and forty and a half chain distances, cast-iron rollers nine inches in diameter are substituted for the wooden ones.

The rope is kept well coated with a mixture of heavy Nubian oil, resin oil, and Stockholm tar. The brake wheel bearings are fitted with Stauffer's patent force lubricators feeding a grease compound, and the break band surfaces are lubricated with Graphite paste.

All trucks are attached to the rope per medium of a chain and grips. These grips—see Figure 4, Plate 2—are designed on the cam and lever principle, and are made of wrought material throughout. The pivot pins are of crucible steel $1\frac{5}{16}$ inches diameter, and the cam levers are of Lowmoor iron. The chains are $\frac{7}{16}$ inches diameter best charcoal iron crane chain having a breaking strength of six and a half tons. The maximum gross load permitted for any individual truck upon one grip chain is one and a half tons, and as the resistance on steepest gradient is 1,263lbs. per ton, the safe factor for grip chain is eight, which is not too high, as the intense cold experienced in winter months renders all couplings brittle.

The quick variations in gradient make it necessary to attach the trucks to the rope in such a manner that the rope is free to rise and fall in accordance with the position of the loaded points. By reference to Plate 1, showing the formation line, it will be observed that the section generally falls short of allowing the rope to take the form of the Caternary curve, and the distance between the rope and the track being a variable one prevents, in a large measure, the adoption of any system of continuous working with automatically actuated grips, and, on the other hand, the gradients are so disposed that any attempt to adopt a "Tail Rake" system of working without exterior power would be hampered by the fact that the returning empty rake would take a position upon a rising grade of 1 in $1\frac{1}{2}$ when the corresponding loaded rake was upon a down grade of 1 in 5·2. It is found, therefore, that uploading is handled to best advantage by adopting the present system of a continuous rope with distributed loading.

The trucks are spaced upon both up and down roads, opposite each other, at 350 feet intervals; therefore, an empty truck arrives at the top and a loaded truck at the bottom simultaneously. The trucks are sometimes coupled in pairs at the same station, and the average number of trucks attached to the rope at one time is thirty-six. The iron skip trucks carry 12cwt. of bulk sulphide ore or 8cwt. of bagged Gossan ore. The wooden trucks carry one ton of bagged ore, and are used for the uploading of general goods and mine timber. In general working, the number of truck journeys each way per shift of eight

hours averages 200 to 250. The percentage of up to down loading is not up to tram's capacity, which is about four to one. Seven men are required to operate this haulage; the labour costs, therefore, about sixpence per ton of loading.

At Williamsford terminus the bulk ore is emptied into storage bins which discharge direct into the railway trucks, and the bagged ore is passed down a wood shute which also delivers into the railway trucks.

The capital cost of tramway and plant to date is about £8,750.

PLATE II

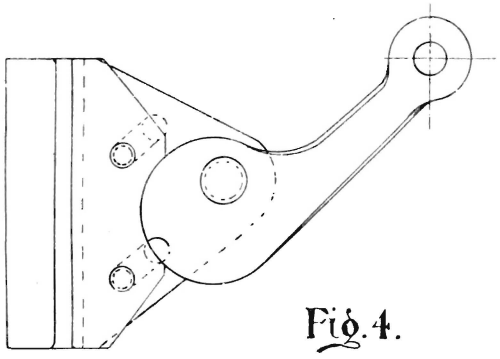
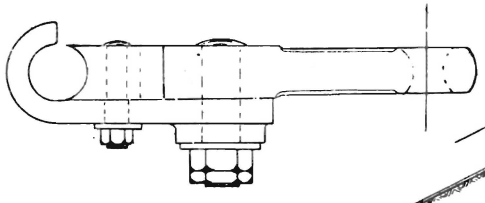


Fig. 4.



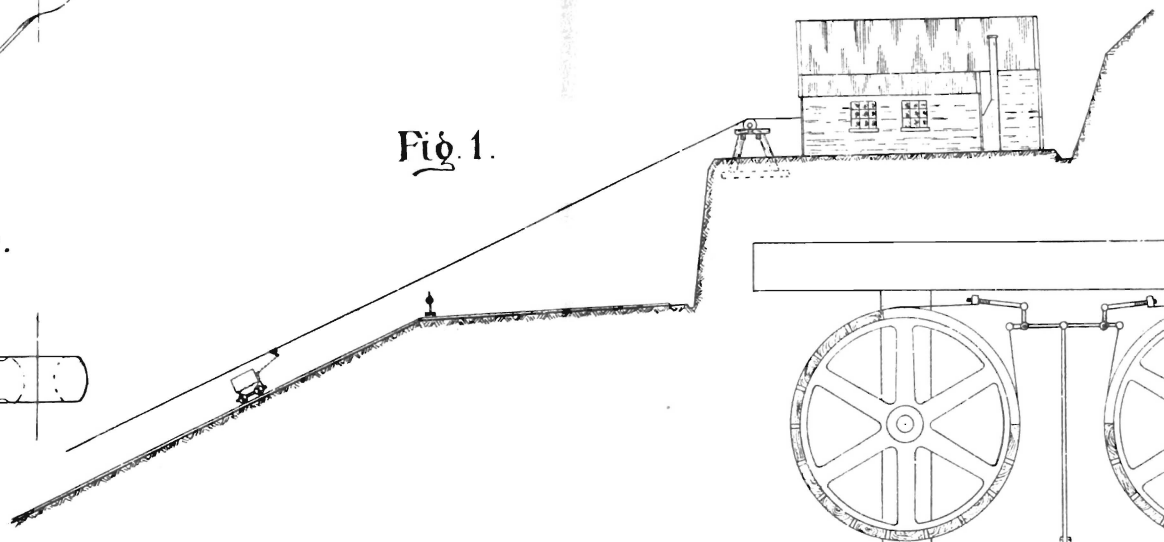
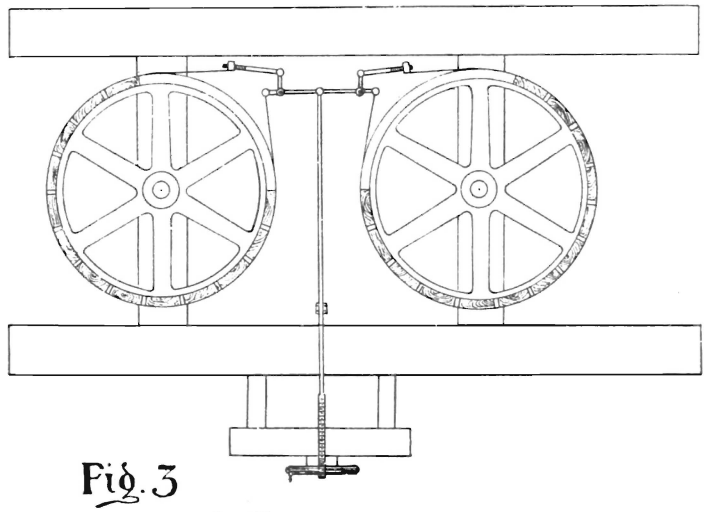


Fig. 1.



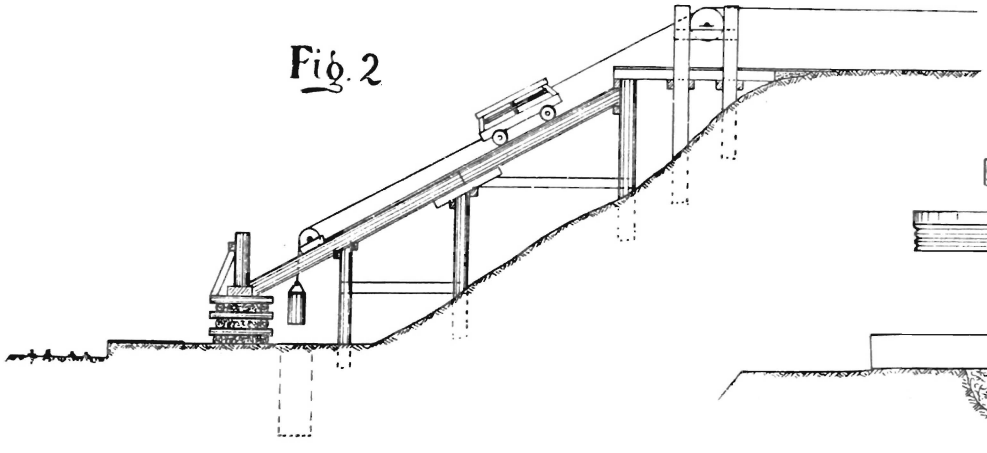


Fig. 2

Fig. 3