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DESCRIPTION OF A NEW ZEALAND COAL MINE.

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The Westport Stockton Coal Company's Mine, which was opened on October 6, 1908, is easily the most interesting coal mining proposition south of the Equator, and, in view of the extent of the coal deposits, and the high calorific value of the coal, one of the most interesting in the world

A general description of the plant will be interesting, as illustrating the combinations of rope haulage and electric haulage used.

The coal deposits lie at a height of from 2500ft. to 3000ft. above sea-level, and the converse of the usual practice had to be met in this case, namely, bringing the coal down instead of raising it, as in the majority of coal mines. The general scheme that has been adopted is the use of two main inclines with steel rope haulage, by which the trucks are handled, the loaded being controlled by a powerful hydraulic brake on each cars going down pulling the empties up, the rope speed incline. From the head of the top incline to the mine the electric locomotives handle the trucks both ways, the small "gathering" locomotives making up the loaded trains by gathering loaded tubs from the various working faces in the mine proper, and breaking up the empty trains, distributing the empty tubs to the faces.

Power House.—The power house is of ferro-concrete construction, and is fireproof throughout. It is 174ft.

long by 50ft. wide, and is divided into three compartments—engine-room, condensor-room, and boiler-room. There are two main generating units, each consisting of a British Thompson-Houston three-phase generator, 375 k.w., 6000 volts, 60 cycle, direct connected to and on common bedplate, with a 475 b.h.p. Bellis and Morcom triple expansion engine, the set running at 400 r.p.m. The engines exhaust into a Worthington surface condenser. Capacity of condenser, 26,000lb. of steam per hour, with circulating water at 55 deg. F. A Worthington centrifugal pump draws circulating water from a well near the power house.

The three-throw Edwards type air pump is driven by an engine of 25 b.h.p. condensing. A Webster feed water heater is installed, capable of raising 26,000lb. of water per hour, 30 deg. F., using exhaust steam from the two boiler feed pumps and the engine driving the automatic stokers.

There are four Babcock and Wilcox boilers, each capable of evaporating 8000lb. of steam per hour, from and at 212 degrees. Heating surface of each boiler, 619 square feet. They are fitted with superheaters capable of superheating 150 degrees. The boilers have automatic stokers and chain grates with 4-speed gear feed, the stokers being driven by a small 15 b.h.p. simple engine.

The boiler feed pumps are Tangye manufacture. There are two of these, each capable of supplying the boilers with 75,000lb. of water per hour against a pressure of 150lb. of steam.

It will be noted that the auxiliaries are of sufficient capacity to take care of the ultimate engine and boiler capacity of the plant, which will be double that at present installed. There are two exciter sets, each consisting of a British Thompson-Houston 14 k.w.

88-volt generator, direct connected to and on common bedplate with Bellis and Morcom simple engine condensing, the set running at 600 r.p.m.

For lighting about the plant and for operating a number of d.c. motors used on the elevators and tipplers in the main coal storage bins, a motor generator set is installed in the power house. This set consists of 100 k.w. d.c. 280-volt flat compound generator, direct connected to B.T.H. three phase 6300 volt, 150 h.p. motor, the set running at 705 r.p.m. The main switchboard consists of eight panels of white marble and three blank panels to provide for future extensions. From left to right, the switchboard is made up as follows:—

Feeder panel for generator of motor generator set.

Generator panel of motor generator set.

Starting panel for motor of motor generator set.

Two blank panels.

Two main generator panels.

Main high-tension feeder panel.

Blank panel.

Two exciter panels.

The d.c. voltmeter for the motor generator set is mounted on extreme left panel, the synchronising indicator and exciter voltmeter, together with Tirrill regulator, being mounted on extreme right panel.

Hoists.—There are two small auxiliary panels near the main board, one for the control of a 40 k.w. 6600 volt primary 230 volt secondary transformer, this transformer supplying current for the operation of a 52 b.h.p. motor, connected to Lidgerwood hoist. This hoist is located near the bins, and is used to pull the Government railway coal trucks out of a dip on to an incline, from which they are distributed by gravity into the various tracks under the bins for loading. After loading, the trucks also run by gravity to the main siding, where

they are made up for despatch to Westport. The second auxiliary panel is for the control of a 75 k.w. 6600 volt primary 230 volt secondary transformer, this transformer supplying current for a 112 b.h.p. motor connected to a Lidgerwood hoist. This hoist has two drums, with a main and tail ropes and corresponding brake and friction clutch levers. The one drum is used for hauling loaded coal tubs from the foot of No. 1 incline through the Ngakawau tunnel to the bins, the other drawing empties from the bins through the tunnel. An auxiliary arrangement is also provided so that tubs and miscellaneous material can be hauled up from the shops and stores to the tunnel level.

Track.—The Ngakawau tunnel is 28 chains long, and has an average grade of 1 in 60, in favour of the load. The tunnel commences about 100 yards from the bins, and runs through to the foot of No. 1 main incline. This main incline has a grade of 1 in 3.25 for 17 chains, and a further grade of 1 in 4.25 for 16 chains, in favour of the load. On this incline the tubs are handled on a steel rope $1\frac{3}{4}$ in. dia., the loaded tubs pulling up the empties, the whole movement being controlled by a powerful hydraulic brake, located at the top of the incline. At the head of No. 1 incline No. 2 incline starts. This starts with a grade of 1 in 5 for 21 chains, and a further 1 in 19 for 17 chains, in favour of the load. The tubs are handled on this incline with a $1\frac{1}{4}$ in. dia. steel rope, this being controlled from an hydraulic brake located at the top of No. 2 incline, the method of operation being identical with that on No. 1 incline. Jacket water for the cylinders of both the hydraulic brakes is supplied under natural pressure.

Electric Locomotives.—At the head of No. 2 incline the trucks run on to a level plat, where the main electric locomotives begin their run. The main locomotives

deliver the loaded tubs from the mine to the head of No. 2 incline, and pull back the empty tubs. At present the company has three of these main locomotives and two gathering locomotives. The main locomotives weigh 20 tons each, and are equipped with Sprague-General electric control, to enable them to be worked as separate units, or coupled, as desired. Their draw-bar pull is 7500lb., with a speed of 8.2 miles per hour.

In order to guard against any possible chance of a locomotive taking down a loaded train of trucks getting away on the steeper grades, a third rail is located in the middle of the track, projecting a few inches above the level of the two outside rails, a very powerful toggle brake on the locomotive engages both sides of the head of this centre rail, giving tremendous braking power. This type of brake is known as the "Fell" brake, and has been applied by the engineers of the General Electric Company to these 20-ton locomotives. The smaller "gathering" locomotives weigh about $6\frac{1}{2}$ tons each, with a draw-bar pull of 2500lb., and a speed of 7.4 miles per hour.

The d.c. trolley potential throughout is 250 volts. As before stated, these small "gathering" locomotives are for pulling the full tubs to be made up in trains for the bigger locomotives to handle, and for breaking up the trains and distributing the empty tubs to the working faces.

The coal tubs weigh 1500lb. each empty, and when loaded 4500lb.; in other words, each loaded tub carries 30cwt. of coal.

The "gathering" locomotives are equipped with a reel, automatically worked from the locomotive's axle, containing 300ft. of flexible twin cable, to enable the locomotive to have an operating range of this distance beyond the farthest point of overhead construction.

The track from the head of the top incline right into the mine is of extremely solid construction for this type of work, having 56lb. rails of substantial sleeper construction. The rails are 40ft. long, and at each joint are bonded with two No. 00 bonds, being cross-bonded every three rails. The gauge is 36in.

From the head of the top incline, where the main locomotives hand over the loaded trains, to No. 1 sub-station, is 35 chains, grades varying from 1 in 132 to 1 in 12, an average of 1 in 25, all in favour of the load, with a minimum curve of 2 chains.

From No. 1 sub-station to No. 2 sub-station at the mouth of "A" tunnel, 145 chains, grades varying from 1 in 12 to level, average grade being 1 in 21, with a minimum curve of 2 chains, all in favour of the load.

From No. 2 sub-station to No. 3 sub-station, through "A" and "B" tunnels, is 79 chains; "A" tunnel being 15 chains long and "B" tunnel 64 chains long—grades varying from 1 in 10 to level, average, 1 in 17. Minimum curve, 5 chains radius.

"A" tunnel has been run purely for construction purposes, but coal will be won in all the other tunnels.

As the mine is developed, track will be continued through "C" and "D" tunnels, extending 110 chains beyond No. 3 sub-station, and excellent coal has been proved for two miles beyond this point. The track is single at present, and is provided with necessary turn-outs to handle the traffic. In the whole layout, however, provision has been made for double tracking throughout.

Overhead Construction.—This is also of a most substantial character. The trolley used is G. E. Co.'s grooved No. 0000 throughout, and in parallel with it for the whole run is a bare stranded cable of 600,000 c.m. The feeder cable is tied to the trolley on an average every 150ft. The trolley wire is 7ft. 8in. from the level of the head of rails.

Sub-stations.—Three sub-stations feed the overhead trolley network. These are identical with regard to electrical equipment. In each sub-station is a motor-generator composed of a d.c. 280 flat compound 200 k.w. generator direct connected to and on common bedplate with a 3 phase 6300 volt, 300 b.h.p. motor, the set having three bearings.

The switchboard consists of three panels of white marble.

From left to right:—

Starting panel for motor with automatic oil switch.

D.C. generator panel.

D.C. feeder panel with voltmeter on swinging brackets.

Transmission Line.—The three sub-stations operate in parallel, and are served with 3 phase current at 6300 volts, the transmission lines throughout being No. 0 hard drawn bare copper. Total length of transmission line, six miles. A lightning arrester ground wire of fine No. 16 stranded galvanised wire is run throughout the high-tension line, stapled to the top of each pole, and is effectively grounded on an average every fourth pole, the distance between the poles averaging 150ft. There are nine transpositions in the transmission line.

Telephones.—Telephone lines connect the three sub-stations, power house, offices, etc., on metallic return, and are run on the transmission line poles from the power house to the beginning of the tramway track, and from that point to the end of the line follow the overhead construction. Each locomotive carries a portable telephone, by means of which a train can at once communicate with any of the points on the telephone network.

Ventilation.—With regard to ventilation. The mine is exceptionally fortunate in this respect in that but

small fan capacity is required to assist and maintain the natural ventilation. Two fans, each driven by a 30 h.p. B.T.H. 3 phase 500 volt motor, are used, one being located in the centre of "B" tunnel and the second in the centre of "C" tunnel. These motors are belted to centrifugal fans. The object in using 500 volt 3 phase motors for driving the fans is that this service will be continuous, irrespective of any possible interruptions to the trolley overhead network. In addition to the above, there are six Sturtevant blowers, each belted to a 5 h.p. d.c. 250 volt motor, which will be located as required at different parts of the workings; the motors taking the current from the overhead trolley.

Drainage.—The natural drainage is so excellent that the only provision made is a small Worthington pump, direct geared to a 5 h.p. 250 volt d.c. motor, this outfit being portable and readily moved to any point of the mine where it is necessary to pump out any small dips that will occur in working.

Coal Cutting.—For winning of the coal, machines will be principally employed. The company is starting with two Sullivan board-and-pillar chain machines, with 6ft. cutting bar, driven by a 30 h.p. motor. These are the first machines of their class used in New Zealand. The company has already proved 30,000,000 tons of coal in sight, the coal averaging about 14,000 British thermal units, being practically as good as the very best Welsh coals mined. The seams vary from 6ft. to 12ft. in depth in the workings already opened, and the coal is entirely free from slate and bands.

Timber Reserve.—The company have a 50-acre reserve thickly wooded with black and grey birch, red and white pine, reaching from the Ngakawau River to No. 2 incline, where drive starts. This timber is available for sleepers and posts for transmission lines, etc.

At the conclusion a few slides will be shown of the various coal cutting machines used in different mines.

With regard to the actual workings, the mine is fortunate in having a solid sandstone roof, which will necessitate the use of very little timber for its support; this fact necessarily greatly increasing the rapid working of the coal, with a corresponding decreased cost of production.

Storage Bin.—The main bin into which the coal is finally delivered has a capacity of 5000 tons. It is divided into three compartments, two of 2000 tons each, for the storage of unscreened coal, and one of 1000 tons capacity, for the storage of screened coal. The loaded tubs run into the bin by gravity, being thrown into any one of the tipples as desired, when they turn over and discharge the coal on to the travelling elevators, which, in turn, deliver it to the various bin compartments. The tipples work automatically, the loaded tub, in turning over, carrying up an empty tub, which is then run down on the siding ready to be made up in a train for its trip back to the mine. The main bin is composed entirely of ironbark, built on pile foundations. Its loading capacity, if required, is 35 trucks at a time. The loading doors work in a horizontal plane, and are opened and closed by hydraulic rams, operated at a pressure of 220lb. per square inch, the pressure being obtained from a small stream near the top of the main incline.

The three elevators are operated respectively by two 10 h.p. and one 15 h.p. motors, and the shakers are operated by three 5 h.p. motors. After coal is delivered from the bin into trucks of the Government railway, these trucks, averaging about nine tons each, are pulled 22 miles to tidewater at Westport, on the West Coast of New Zealand; this port at present admitting steamers to a draught of 22ft., although the Government has

authorised the expenditure of £200,000 to facilitate coal handling and enable steamers of 30ft. draught to enter the port. Other large coal deposits in the neighbourhood are being taken up, and will, in the near future, be in operation, making Westport one of the largest coal handling ports in the world. Although the mine is on the coast, no harbour accommodation is nearer than Westport, which, at present, is able to handle 1,250,000 tons of coal per annum.

Before drawing to a close, after having heard the description of this mine and equipment, every one of us must admit that it has been a great engineering feat, and that the engineer to the company, Mr. Broome, proved himself a remarkably capable man by the very complete and excellent layout he has made of the whole mine; also the electrical engineer for the contractors, who also had a great share in the ultimate success of the undertaking.

The latter gentleman, Mr. Schmidt, who is an intimate friend of the author's of over twenty years' standing, he had to thank for the description and photographs he has allowed him to use in reading this paper; and, as Mr. Schmidt was present, he would, he was sure, give any further details if any member would like to know anything more.

The paper was illustrated with a large number of lantern slides, the most important of which are shown in Plates XXXII. to XXXV.