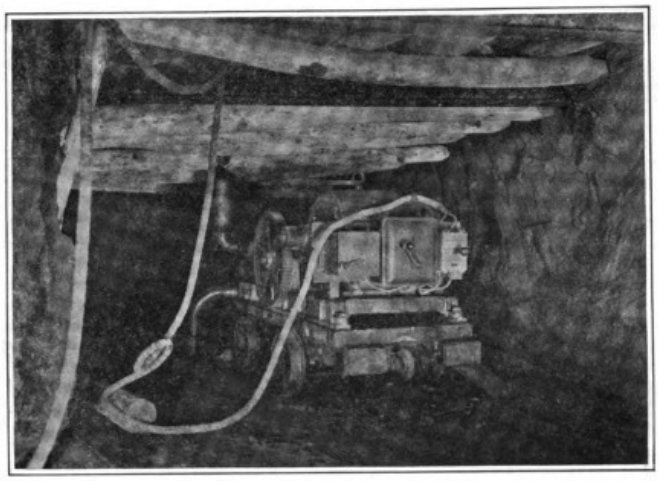
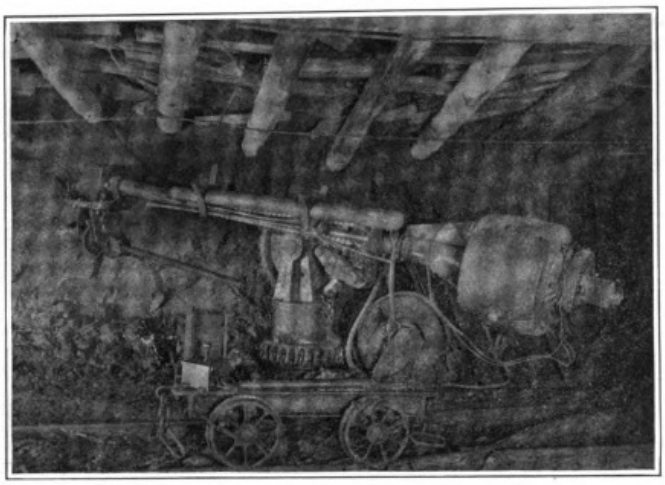


Portable Track Pump and Motor on Bogie at Whitecliffe Mine.



Five Horse-power Motor Driving Rock Drill.

The Electrically Operated Loftus Ironstone Mine

A Representative of Up-to-date Practice in Great Britain

In Yorkshire, England, about four miles from Saltburn are situated the Loftus ironstone mines consisting of two adits driven in the hillside on the east of the deep valley dividing Loftus from Carlinhow. The drift which extends in a southeasterly direction, is operated by a steam hauling engine at the surface, which serves three different districts; first the Whitecliffe mine, lying underneath part of the township of Loftus; second the Loftus mine proper, farther to the north; and third, the Grinkle mine some two miles distant.

The electrical equipment has been installed at this south drift, while nothing in the way of electrification has been done with the north drift. The Whitecliffe engine plane and the various districts are operated by electricity, and there is an electrical equipment for underground haulage. The electric hauling engines were required to be placed so that the lead of the rope should be as straight as possible and so arranged that either electric haulage equipment could relieve the other in case of breakdown or stoppage. The in-bye haulage roads meet at the bottom of the drift from the surface and at this point the ropes from the two haulage systems cross. The endless rope haulage system is operated by an electric motor driven haulage gear with rope transmission. There is a direct connected electric equipment in No. 4 haulage room and a rope driven electric installation in No. 5.

The electrical equipment of the Loftus ironstone mines is interesting for it includes a number of rotary electric drills, each of which is capable of boring 30 holes from 3 to 4 feet in length and 1⅜ inches in diameter per hour. It does this work continuously, each electric drill carrying its own supply of trailing cable on a special drum fitted with a sliding contact. The drill carriage is provided with regulator and starting switch. The electrically driven drainage pumps in use are of unique construction, being of the ram type and delivering their water to the sump which supplies two centrifugal pumps. The portable electric drainage pumps are provided with direct-geared motors, one of them being capable of delivering 50 gallons per minute and the other 90 gallons. They are readily moved wherever desired, the electric switches being mounted on the pump framework together with the starting resistances. A direct current is employed for operating the pump motors as well as those of the electric drill.

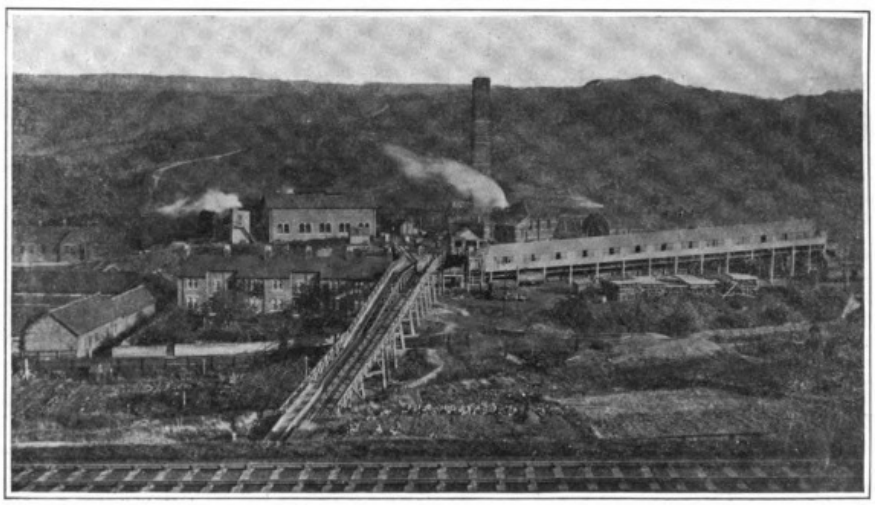
In the centrifugal pump room there are two electric motors, each of 85 horse-power capacity, directly coupled to rotary pumps which deliver 600 gallons of water to the surface per minute against a head of 300 feet. These pumps are run alternately. The motors are started by means of liquid switches and each pump set is provided with a switch column consisting of a double pole switch with circuit breaker and ammeter, the whole being iron clad and fire proof.

In addition to the pump and drill operated by continuous current from the gas engine power plant, direct current is also used for the endless rope haulage room which is equipped with a 100 horse-power multipolar motor designed to operate at a speed of 525 revolutions per minute. This electric haulage gear consists of two rope wheels each 6 feet in diameter arranged to run at a speed of 7 revolutions per minute, thus giving an approximate speed of 1½ miles per hour on the rope. The entire electric equipment of the Loftus ironstone mine was constructed at Gateshead-on-Tyne, England, and is considered to be representative of the most up-to-date practice in Great Britain.

For haulage service, electric power is obtained from a sub-station at the mine located near the power house, this sub-station receiving electric current from the Cleveland and Durham electric power company. On account of the intermittent nature of the load on the haulage roads of this mine, electric power was obtained from the power company named, while a gas engine electric power house was installed at the Loftus mines for operating the centrifugal pump, the electric driven drainage pumps, the electric drills at the face and for electric lighting underground as well as at the surface. This power station at the mine also supplied the necessary electric current for the Whitecliffe mine in this rope haulage service.

There are three four-cylinder vertical gas engines of the Campbell type constructed at Halifax, England, in the Loftus mine power plant. Each of these vertical gas engines is directly coupled to a generator of 230 kilowatts capacity, supplying a direct current at a pressure of 550 volts. The gas engines are operated by gas from three suction producers from Durham Coke breeze obtained from the colleries of Pease & Oartners, Ltd., who also own the Loftus mines. The continuous current from the gas engine power station was used for two years for driving the haulage gear which was originally operated by a horizontal steam engine in No. 5 haulage room.

This plant consisted of a 250 horse-power direct-current motor, operated at a normal speed of 375 revolutions per minute and regulated by means of a controller of the railway type with iron grid resistances. On account of the unavoidably intermittent nature of the load, the voltage of the whole system of direct-current electric lighting was affected every time the rope driven haulage gear was started. This caused also irregular working in the gas engine power station, and, to overcome the difficulty, the motor was placed on the three-phase circuit of the power company. The high tension current was conducted down the drift by a three-core cable of 0.15 square inch area which was laid solid under the traveling road. From the junction of these cables at the distributing board, smaller cables were led to the No. 5 haulage room, each having an area of 0.075 square inch. The current was conducted through these cables to the present three-phase motor of 250 to 300 horse-power capacity, which also in case of necessity does the work usually handled by the No. 4 electric haulage plant. The motor is wound for 2,750 volts, a frequency of 40 cycles per second and operates at a speed of 347 revolutions per minute. In the No. 5 haulage room, this motor drives the haulage gear through an intermediate shaft by means of cotton rope. A metallic controller of massive construction is in service. This controller has three sections each having 15 stops, with one section for each phase. There is a quick brake switch with a positive action for each stop and in addition a spring brake so arranged that in case of the spring failing, the switch will still be effective. In this controller, each stop is connected by an insulating cable to an elaborate series of resistances installed in galvanized iron tanks three in number, one for each phase and filled with oil of high quality. The tanks are fitted with heavy copper circulating pipes through which cooling water is forced by means of a centrifugal pump operated by the shaft of the electric motor. The controller is operated by means of a hand wheel on the end of a long steel rod on the operating platform and connected with the oil-filled, high-tension reversing switch. The handle of this switch is interlocked with the main wheel, so that until the wheel is in the "off position" the connections cannot be reversed. There are water-filled resistance tanks also provided to supplement the oil-cooled metallic resistances above mentioned. Each of these water tanks holds 190 gallons and is constructed of 1½-inch elm plank. In starting the electric motor, these



The Loftus Ironstone Mines, Yorkshire, England.

water-filled resistance tanks absorb a large proportion of the energy, giving a very gradual acceleration to the haulage gear when a set of cars are picked up. These liquid tanks are coupled to the first three stops only of the controller and are then relieved of further work, the additional regulation being carried out by the water-cooled metallic resistances alone, beyond this point.

It is of interest to note that for the purposes of allowing the slack to be taken up gently between cars and for adjusting the length of the rope, a steady speed of from one to two miles per hour can be maintained by the haulage gear with the water tanks in circuit. There is a water receiver provided for the cooling of the metallic controller connected with the electric driven centrifugal pump by steel pipes 3 inches in diameter. This electric haulage installation is used to bring trips of from 30 to 50 tons at a time over the somewhat uneven road from Loftus or Grinkle. In the latter run there is a length of travel of 2,500 yards taking 10½ minutes from start to finish, with an average speed of 8¼ miles per hour.

In passing from No. 5 electric haulage room along the rope plane will be noted the junction of the Whitecliffe plane and Grinkle plane where is installed the 300 horse-power electric haulage gear of the direct connected type in the new No. 4 haulage room. The electric motor equipment water tanks and resistances as well as the controller and the main switchboard are the same in this installation as in No. 5 haulage room above described, but the haulage gear is of special interest owing to its massive design and great power.

There are two drums on the barrel, each 2 feet 8 inches wide and 6 feet diameter with a shield board 8½ feet in diameter over all. This electric gear of high power operates the Whitecliffe mine district where a large body of ore remains to be handled. The equipment operates at the comparatively high speed of 9 miles per hour, requiring a speed of 40 revolutions per minute on the drum shaft. A special friction clutch of the Hall type is provided on each of the two drums, consisting of a heavy cast iron center, keyed to the main shaft and revolving with it. There is an all-round brake strap 6 inches wide outside this center, provided with elm blocks and operated by means of rods and levers inside the haulage drum and connected to a sliding sleeve between the drums. The position of this sleeve is regulated by means of a handwheel with double threaded screw, and is so arranged that either drum may be stopped or put in motion as desired, the wear on the strap blocks being taken up by screws at the end of the straps.

The haulage gear is connected to the rotor shaft of the electric motor which operates at a speed of 325 revolutions per minute. This motor is capable of developing 450 horse-power at a maximum and is supplied with a two-phase current of 2,750 volts pressure. The motor has a wound rotor with massive slip rings outside of the end bearing, protected by a sheet iron cover. There is a cast iron box underneath the motor containing liquid resistances for absorbing the shock when switching out; this accessory being found of great advantage owing to the very frequent starting and stopping of the motor.