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CIVIL ENGINEERING.

*Description of the Compressed Air Engine at Govan Colliery.**

By W. C. RANDOLPH.

[Read before the Institution of Mechanical Engineers, Glasgow.]

This engine was designed for a special purpose in the working of the Govan Colliery, near Glasgow, where an ordinary engine was not applicable; and although under other circumstances not an economical mode of employing power, it has proved in the present case highly satisfactory, and has worked successfully for several years.

The main shaft is sunk 176 yards deep, through six successive seams of coal, the first of which is 92 yards from the surface at that point; and after working the coal at that part, a main road was driven horizontally to a distance 706 yards, intersecting the coal seams, which dip at an inclination of about 1 in 11. A second shaft, at present 26 yards deep, was then sunk near the extremity of the main road, for the purpose of working the third seam, or "rough main" coal. The difficulty then arose of providing for the winding and pumping of this second shaft at a distance of nearly half a mile from the first shaft. A steam boiler was inadmissible in that situation, and the distance was too great to convey steam from the surface. Some application of water power was contemplated by the manager, Mr. James Allan, who applied to the author for the purpose of carrying it out; and it was then proposed by the author, upon the original idea suggested by Mr. David Elder, to make use of compressed air supplied by a compressing steam engine at the surface, and conveyed down by a pipe, to work an engine

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at the top of the second shaft, in the manner of a non-condensing steam engine, the discharged air being thrown into the workings to aid in the ventilation of the mine. This proposal was adopted, and the present engine was designed and constructed for the purpose, by Messrs. Randolph, Elliot & Co. ; it has now been working at the colliery more than six years, and has been found to answer the purpose completely.

The main shaft contains a single winding apparatus and a set of four pumps, and forms the downcast shaft for the ventilation ; it is 18 feet long and 8 feet wide, being oval at the top and rectangular below. It opens at the bottom to the horizontal main road, which is 9 feet wide and 6 feet high, divided by a brattice in the centre throughout the whole length, for the downcast and upcast currents. The upcast shaft, 7 feet diameter, has a ventilating furnace at the bottom, and contains a single winding apparatus. In a recess at the top of the second shaft, is fixed the air engine for working the winding and pumping apparatus of the second shaft. The compressed air is conveyed to it by a cast iron pipe, 10 inches diameter inside, carried down the main shaft, from a steam engine at the surface, which is employed to compress the air.

The steam cylinder is 15 inches diameter, with a stroke of 3 feet, and drives two condensing air pumps, which work alternately one on each side of the beam centre, delivering the air into the centre reservoir, from which it passes into the main pipe. The beam is connected at the other end to a crank and fly-wheel, to equalize the motion. The air pumps are 21 inches diameter, with a stroke of 18 inches ; they are placed inverted, with the piston rods passing out below, where the stuffing boxes are not exposed to the pressure of the compressed air, and are worked with crossheads sliding in vertical guides by means of side rods from the beam. The air pumps are fitted with ball-valves, of which there are three sets to each pump, each set consisting of 44 brass balls, 2 inches diameter, arranged in three concentric rings. The balls are confined by separate cages to a lift of half an inch. In consequence of the high pressure of the air, amounting to 30 lbs. per square inch, provision is made for preventing leakage through the valves, by a stratum of water constantly covering the piston valves and the delivery and inlet valves, through which all the air has to pass. A small pump, 3 inches diameter and 10 inches stroke, is employed to supply water for this purpose, and delivers it into the centre reservoir, from which it flows through the small pipes, into each of the air pumps, during the period of their downward strokes; the quantity of water admitted being regulated by a cock in each pipe. The surplus water is discharged at each upward stroke through the delivery valves, and flows over the top into the centre reservoir, keeping the delivery valves also covered with water ; in this way the compressed air is entirely discharged, and there is no loss of power from expansion of air behind the piston at the beginning of the downward stroke. The level of water in the centre reservoir, is regulated by means of a gauge glass at the side. Any leakage of water past the piston valves and piston, escapes through the suction or inlet valves, and is carried off by a waste pipe fitted to the casing of the air pumps.

The air pump barrels are lined with brass to prevent corrosion, and

the pistons are faced with brass and without packing, being merely turned a good fit to the cylinders. The pumps have continued working the whole time since starting, a period of more than six years, working part of the time day and night, without requiring any repairs or adjustment; nothing has been done to them, except replacing some of the valve cages which had been broken.

The usual speed of this engine is about 25 revolutions per minute, with a pressure of steam of 18 lbs. per square inch, giving a pressure of air averaging about 20 lbs. per square inch.

The air engine at the lower shaft has a cylinder 10 inches diameter and 18 inches stroke, and works usually at about 25 revolutions per minute; it is an old steam engine, and was formerly worked with high pressure steam. It was intended to be worked with air at 30 lbs. per square inch pressure, and at that pressure the heat generated in compression was expected to be very great; indeed, calculation at the time gave nearly the melting point of tin. The great safety valve, however, for getting rid of the heat developed, is, as was anticipated, the water upon the valves of the compressing engine, which absorbs the heat as soon as generated, a portion of the water passing off through the main pipe in the form of steam; this steam becomes condensed in the pipe, and provision is made for drawing off the water of condensation from time to time as it accumulates at the bottom of the shaft, by means of a cock.

The pressure of the air at the lower engine, is only about 1 lb. per square inch below the pressure of the compressing engine at the top of the pit. The absorption of heat on the sudden liberation of the compressed air from the lower engine, at the discharge of each stroke, causes so great a degree of cold, that in winter the engine is often stopped by the formation of ice in the cylinder and exhaust pipe.

*On the Geology and Physical Geography of North America.** By Prof.

HENRY D. ROGERS, from the United States.

(Continued from page 326.)

AMERICAN COAL FIELDS.

The speaker selected from the many topics presented by this sketch of the geology of North America, that of the coal fields of the United States and British Provinces, as presenting a theme of general interest, describing first briefly the carboniferous formations, especially their coal measures.

This formation consists, in the United States and North-eastern British Provinces, of argillaceous and siliceous sandstones, conglomerates, clay shales, fire clays, and coal slates; argillaceous limestones, chiefly of marine origin, and seams of coal. A coarse siliceous conglomerate or millstone grit, generally destitute of coal, underlies the productive coal measures throughout nearly all the different basins, proving the universality of the action which attended the commencement of that state of

* Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.