flames when it escaped on the other. In the lower part of the cabinet inside he lit two large gas flames, and the hot air from these rising in the cabinet intercepted the sound, so that the flame ceased to be shortened. He thus proved that invisible columns of heated air would cut off sound. He then put out the burners and lit a piece of phosphorus placed in a saucer at the bottom of the cabinet, the latter of course was soon filled with a thick smoke of phosphoric acid—so thick was it, that it cut off from view a lighted candle which was placed at the back of the cabinet, yet this cloud, which was so powerful in cutting off the rays of light, did not interrupt the waves of sound at all. Having thus proved that invisible warm air may act as an acoustic cloud, he said that when such clouds are close to the source of sound the echoes are immediate and mix with the original sound, but if the acoustic clouds are further off, then there are prolonged echoes. Further, the length of an echo is a measure almost of the depth of the acoustic cloud from whence it comes. In the experiments at the South Foreland he discovered that when a sound penetrated to a great distance, then the echoes were longest.

At the close of his lecture he argued that the phenomenon which Arago could not explain was due to warm air from the chimneys of Paris, forming acoustic clouds which surrounded the station at Villejuif, whilst the other station at Monthlery was free from this heterogeneous atmosphere.

AIR-COMPRESSING MACHINERY, ST. GOTHARD TUNNEL.

Machines for compressing air have of late attracted much attention as the best means at present in use of transporting power to considerable distances. The practical success of the system has been fully demonstrated at the St. Gothard Tunnel Works, where the mechanism used is the most powerful *of its kind that has ever been erected, the gross horse-power* that can be erected being not less than 1120-horse power The air compressers are driven by a fall of water with an effective head of 95 metres, or about 310 feet, and are described as follows in the *Engineer*.

They are of the Girard, or "free deviation" type, which has been selected by Messrs. Roy, after thirty years' experience in turbines, as about the best yet produced. The construction of this wheel will be readily understood. In ordinary horizontal turbines the water is admitted through the fixed vanes all round the wheel, but in the Girard turbine there is a fixed internal guide, which is but a segment of a circle, and through this the water is directed on to the eighty buckets in the outer or "crown" wheel, as it is yet inaptly called. To a certain extent the action is that of a Poncelet wheel, the head of *water being very great, while its volume is small. The wheel* is surrounded by an iron casing to prevent splashing, and the water is led to the delivery vanes by a flattened tube D. The crown wheel is shown at E. The distributor, or delivery vanes, has eight orifices covered or uncovered by a curved sluice, which can be worked by a rack and pinion and the gearing *b b b*. A large sluice C, is provided for each wheel, between it and the water main A, in the branch pipe B. By the use of these sluices the water can be cut off from any particular turbine when required by the gearing *a*. The turbines make 160 revolutions per minute, consuming 300 litres, or 66 gallons of water per second. The outside diameter of the wheel is 7·8 ft. nearly, and under these conditions each wheel gives off 280-horse-power. The shafts F, of the turbines are all in line, and united by coupling boxes K K. These shafts *carry six pinions G G, which gear into six spur* wheels H H, mounted on the three-throw crank shafts L L. These drive three air compressers R R, by the connecting rods M. In order to diminish as much as possible the irregularity of the resistance due to the compression of the air, the compressing cylinders have been combined in threes, as shown.

The work required from each pump and compresser is to deliver 141 cubic feet of air per minute under a pressure of 7 atmospheres, or nearly 105 lb. on the square inch. If necessary, however, the air can be compressed 9 atmospheres, or 135 lb. nearly, on the square inch. When the turbines run at 160 revolutions the compresser shafts make 80 revolutions. The diameter of the cylinders inside is 0 420 metres, and the piston stroke is 650 metres. These dimensions give 175 litres per revolution, or 42,024 litres per minute for each group of *three cylinders. This volume of air is reduced to 5,253 litres* net, at a pressure of 7 atmospheres, and 1,253 litres are allowed for clearance and port spaces, or 0 31 of the required volume. The theoretical power required to effect the compression of the stated volume of air is by the formula p . . *hyp. log.* $\frac{P}{p}$—*152-horses, which it will be seen is well within the* power of the turbines, which can develope if necessary 280-horse power each

Hitherto one of the great troubles encountered in working air-compressing machinery lies in the difficulty met with in keeping the cylinders cool The temperature, if unchecked would rise in the cylinders under notice to about 500 deg Messrs Roy have adopted an extremely ingenious device to prevent the elevation of temperature The pistons are so constructed as to permit a continuous circulation of water to go on inside them, and besides this, they are practically water-packed in the following way. Each piston is hollow and placed in communication with a special set of water pipes by the tube N, within which is a second tube Q, a stuffing box being fitted to N, which slides on Q. The packing of the piston consists of four brass rings in grooves, these grooves communicate with the interior of the piston The water is admitted to the piston under a head which is greater than that which could be sustained by air of the given pressure, and the water therefore forces the rings out, but the rings are not quite tight in the piston, and a constant small leakage of water goes on, which is evenly distributed over the whole interior of the cylinder, and at once serves to make the piston air-tight, for lubrication, and to keep down the temperature. We understand that the device acts most efficiently. This water is taken from the main A under a head of 310 ft., and this suffices, when the compressers are working up to 7 atmospheres. When, however, a pressure of 9 atmospheres is required, the water would not enter the cylinder under the given head, and in order to obtain the required supply a small pump *d* is provided, which can be driven by belt pulleys from the shaft I. This pump draws from the main E. It makes 26 revolutions per minute, and thus delivers 2 litres or 1·76 quarts per second. As it is essential that the water should be perfectly clean, it is passed through the filter or strainer *e*, which contains three wire sieves of smaller and smaller mesh, by which impurities are removed. On leaving the filter the water either passes direct to the air compressers or to the pump by which its pressure is to be augmented.

The air enters the compressing cylinders through two valves near the upper edge of the cylinder covers, as shown in the enlarged section of a compresser at page 100, and escapes through three smaller valves fixed near the lower edges. The air mixed with the water required to cool it then passes through the self-acting valves to the receiver X, at the base of which is a cock, worked by a spherical copper float, and in such a way that when water accumulates in the receiver the cock opens and discharges it, the action being precisely that of a well-known form of steam trap. A plate iron cone is fixed over the float to prevent the incoming rush of air from affecting it. In practice the discharge of water is constant, being regulated with the utmost nicety by the float. The air ultimately passes away by the pipe T to the main reservoirs, from which the rock drills are supplied

The Cape Breton *Times* is informed by Mr. Gisborne that, with the exception of small sections of one or two earth cuttings, the remaining half of the entire railway route is now ready for laying the rails, both sleepers and metal being already delivered upon the line. The early completion of the railway next spring is thus assured, and the wishes of the sub-contractors to suspend operations until the enormous accumulations of snow have disappeared has been agreed to, £5,000 to £6,000 additional expenditure is all that will be required to complete the contract.

At a recent meeting of the First Judicial District Dental Society, W. G. A. Bonwill recommended the diamond drill for the permanent separation of the incisors. The shape is pyramidal. It makes about five thousand revolutions per minute, and, in consequence of its extreme rapidity, causes not the least pain, even when cutting upon the most delicate enamel. Working so rapidly and perfectly, it will cut through or over the surface of the poorest fillings, without disturbing them in the least.