THE USE OF BLAST-FURNACE GASES IN GAS ENGINES.

DURING the past year all the difficulties in the use of blast-furnace gases have successfully been overcome, and it is interesting to consider the rapid progress that has been made in this important development of metallurgical practice. The question was first taken up by Mr. B. H. Thwaite in 1894, and a 15 horse-power engine, worked by blast-furnace gas purified by his apparatus, was set to work at Wishaw, in Scotland, in February 1895. Since that date numerous small motors have been in operation in this country using purified blast-furnace gas driving machinery and dynamos. In the development of large motors and in their adaptation to blowing engines Belgium has taken the lead. In May 1898, Mr. A. Greiner, of the Cockerill Company, described a 200 horse-power engine in successful use at his works. The results attained stimulated experiment in Germany and in Luxemburg. The Cockerill Company, however, continued to take the initiative by starting, on November 2, 1899, the largest gas engine ever built. On May 9, 1900, Mr. Greiner described the engine to the Iron and Steel Institute, and gave the results of six months' working. This was the first gas engine to run the blowing engine of its own furnace. Results of tests of this gas engine, by Prof. Hubert, of Liége, are given in an appendix to an exhaustive paper on power gas and large gas engines, read by Mr. H. A. Humphrey before the Institution of Mechanical Engineers on December 14, 1900. The engine was designed by Mr. Delamare-Deboutteville, and built by the Cockerill Company. It is a single cylinder 600 horse-power engine, working on the Otto cycle, and direct coupled to a double-acting blowing cylinder. The large engine and blower shown by the Cockerill Company at the Paris Exhibition was a duplicate of the one under discussion. It was rated at 700 horse-power on blast-furnace gas, at 800 horse-power on producer gas, and at 1000 horse-power on illuminating gas. In an exhaustive paper on the subject, published by Prof. Joseph W. Richards in the current number of the *Journal* of the Franklin Institute of Philadelphia, the following list of blast-furnace gas engines now in operation is given :—

	No.	Horse-power.
Seraing, Belgium	4	500
Differdingen, Luxemburg	4	500
Hoerde, Westphalia	2	600
	2	1000
Friedenshütte, Silesia	2	200
	2	300
Oberhausen	1	600
Dudelingen	2	600
	2	1000
Kneutingen	2	500
Roechling	1	200
	2	600
Ruhrort	1	500
Barrow, England	—	1000
Toula, near Moscow	3	600
	3	200
Island of Elba	—	1000

The Cockerill Company is now constructing, for the Roechling Ironworks in Lorraine, three 1200 horse-power gas engines. They are double-cylinder tandem engines directly attached by a tail rod to the blowing cylinder. The Cockerill Company and Mr. Delamare-Deboutteville have now decided to build engines of 2500 horse-power. They will have two tandem cylinders on each side of the dynamo, giving four cylinders per engine. They are designed for a central electric station.

In view of the remarkable results already attained, there can be no doubt that during the next few years the design and erection of large central power-stations for the generation and distribution of electric energy in bulk will be one of the most important problems with which engineers will have to deal. The new stations will be larger than any now existing, and every possible effort will be made to reach an unprecedented degree of economy in the production of power. Mr. Humphrey's paper strongly urges the claims of the gas engine to rank as a rival of the steam engine for large power units. The results of a trial of a 400 horse-power Crossley gas engine carried out by Mr. Humphrey are certainly most satisfactory, whilst its capability for continuous work has been shown at Messrs. Brunner, Mond and Co.'s works at Winnington, Cheshire, where it is used for their electrolytic plant. The employment of gas engines in large central station work is, however, still very limited, for out of the total of seven central stations where gas motors are used, the largest has only an aggregate of 650 horse-power, whilst the largest unit is of only 200 horse-power. The use of the waste gases from blast furnaces renders it possible to have a supply of cheap fuel. This result can also, according to Mr. Humphrey, be attained by the use of a Mond producer plant, which is suitable for converting cheap bituminous fuels into suitable gas for gas engines, and at the same time permits of the recovery of the ammonia from the coal as a by-product.

The great industrial revolution which is imminent in the economical utilisation of blast-furnace gases is best shown by the careful calculations made by Prof. Richards of the results that would be attained by the application of this improvement to American blast-furnace practice. As an illustration of average practice, he takes the figures from a blast-furnace plant in Eastern Pennsylvania, which is making in three furnaces 2600 tons of pig iron per week. The composition of the gas by volume is as follows :—

CO_2	CO	H	N
9	27	1·8	62·8

The pig iron produced daily is 370 tons; the fuel used per 100 kilograms of pig iron, 100·0 kilograms; carbon in fuel, 82·9 kilograms: carbon in flux, 4·6 kilograms; carbon in the iron, 3·1 kilograms; efficiency of stoves, 60 per cent.; efficiency of boilers and engines, 4·5 per cent.; pressure of blast, 1·3 kilogrammes per square centimetre (20 lbs. per square inch); and temperature of blast 555° C.

With these conditions, the calculations are as follows :—

Calorific power of gas per cubic metre, 873 calories; volume of gas per 100 kilograms of pig iron, 434·7 cubic metres; calorific effect of gas per 100 kilogrammes of iron, 379,490 calories; heat required to heat blast per 100 kilograms of iron, 90,500 calories; indicated horse-power of engines for blast, 950 horse-power; indicated horse-power of engines for hoist, pumps, &c., per 100 tons of iron daily, 65 horse-power.

From these calculations the following conclusions are arrived at :—

		Calories.
Calorific effect of gases per 100 kg. of pig iron		379,490
Lost (10 per cent.)	37,950	
For heating blast	90,500	
		128,450
Surplus for burning develops ...		251,040
Surplus per 100 tons of pig iron daily		251,000,000

The horse-power at 100 per cent. efficiency would be 16,400; horse-power with steam at 4½ per cent. efficiency, 738; deficit of steam power per 100 tons of iron daily, 277 horse-power; horse-power with gas engines at 30 per cent. efficiency, 4920; surplus power with gas engines per 100 tons daily, 3900 horse-power; deficit of steam power per 370 tons daily, 1025 horse-power; surplus of gas engine power per 370 tons daily, 14,400 horse-power.

It is an actual fact that at the works considered by Prof. Richards the three blast furnaces are charged with 800 horse-power, furnished to them by the boiler plants fired by coal. It is also a fact that nearly 10,000 horse-power is raised for the rest of the plant by coal-fired boilers, and that all of this could be supplied by gas engines utilising the blast-furnace gases. The saving in the coal bill alone would amount to at least 30,000*l.* in one year. The gas-engine plant to accomplish this would cost 100,000*l.* These calculations, based on average practice, bring out very clearly the great saving of power possible by the economical utilisation of blast-furnace gases.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1901.

THE following prizes are offered by the Paris Academy of Sciences for the year 1901 :—

In Geometry, the Francœur Prize (1000 fr.), for discoveries or works useful to the progress of the mathematical sciences, pure or applied; the Poncelet Prize (2000 fr.), with similar conditions; and in Mechanics, the Extraordinary Prize of 6000 francs, for progress tending to increase the efficiency of the French naval forces; the Montyon Prize (700 fr.); the Plumey