extra power. Otherwise a part or all of the waste gases may be used directly in high-power gas engines. The prominent American engineers manufacturing the Nürnberg gas engine in the United States state that in a blast furnace, gas is generated to an amount exceeding 160,000 cubic feet per ton of pig iron produced having a heat value of 85 B.T.U. per cubic foot. About 70,000 cubic feet of this gas is utilized in heating the blast, and about 90,000 cubic feet of gas remains available for power generation.

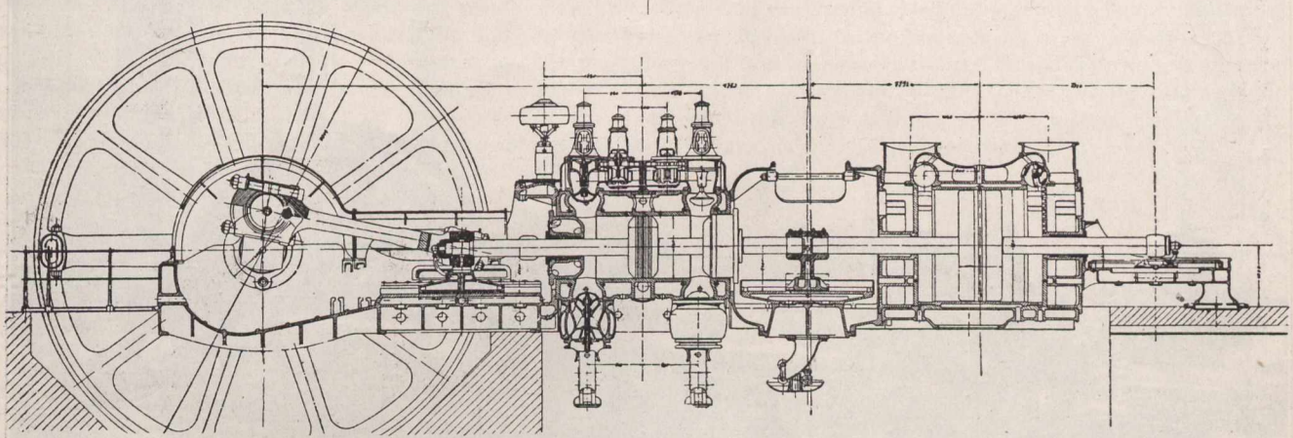
The power required to operate the blast furnace plant, that is, the power consumed by the blowing engines, pumps, mechanical charging apparatus, etc., amounts to about 10 B.H.P. per ton of pig iron produced per 24 hours, or 240 B.H.P. hours per ton of pig iron. Taking as a basis of comparison a blast furnace plant having a capacity of 1,200 tons of pig iron per 24 hours, the following figures will be obtained:

Gas produced per hour, 8,000,000 cubic feet equivalent to 680,000,000 B.T.U. Gas required per hour to heat the blast 3,500,000 cubic feet equivalent to 300,000,000 B.T.U. Gas per hour available for power, 4,500,000 cubic feet, equivalent to 380,000,000 B.T.U.

If burned under boilers to generate steam for compound condensing engines this volume of gas would be sufficient to develop 13,000 horse-power. If utilized directly in gas engines this volume would be sufficient to develop 3,500 Brake horse-power.

Power required to operate the plant is 12,000 Brake horse-power, therefore, if all the available gas be burned under boilers to generate steam for compound condensing engines it would be little more than sufficient to operate the blast furnace plant; while if used directly in gas engines it would not only operate the blast furnace plant, but develop an excess of about 18,000 B.H.P. available for 24 hours, that is 432,000 B.H.P. for other purposes; which latter power, if required and developed in compound condensing steam engines using coal under the boilers, would consume about 860,000 pounds of coal; or in such a plant, the use of steam would be equivalent to an excess in coal consumption of 300,000,000 pounds per annum.

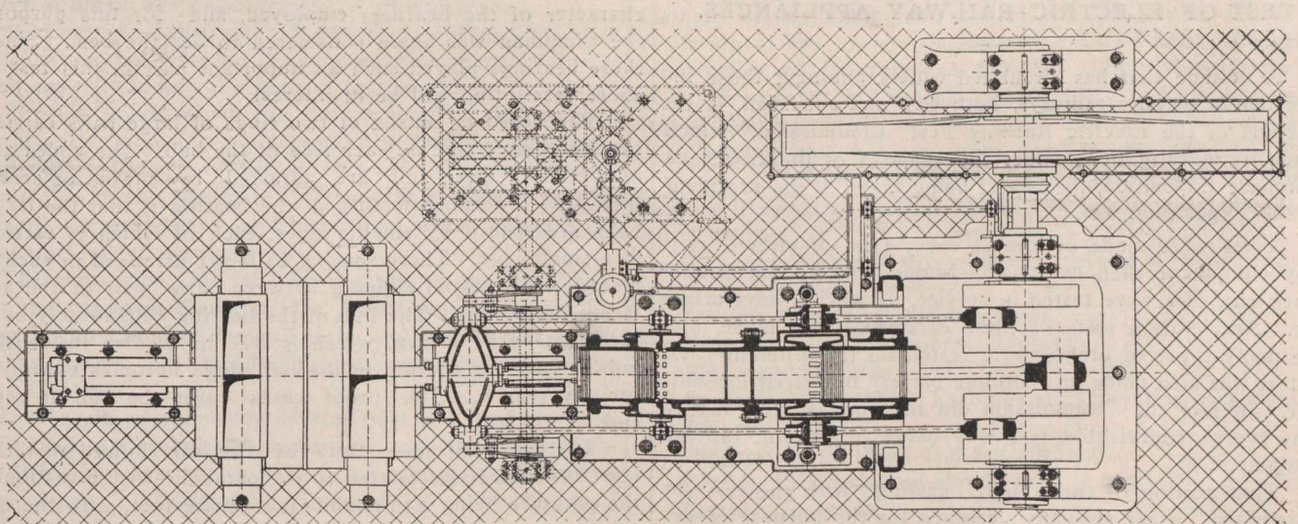
The German high-power gas engine is being extensively introduced in Europe as well as in America for operating blowing engines as well as electrical generators in the large power plants of iron and steel works. These gas engines in utilizing the waste blast furnace gases and coke oven gases



Nurnberg Double-acting Blowing Gas Engine for Iron and Steel Plants.

are most economical in operation and are replacing in many cases the large steam engines heretofore used almost exclusively.

Owing to the more prominent German gas engines of the single-acting and double-acting types of two-cycle and four-cycle designs constructed for large powers, should be mentioned the Oechelhauser of the Deutsche Kraft Gas-Gesellschaft, of Berlin, constructed by A. Borsig in Tegel, and in Dessau and Aschersleber by the Berlin-Anhaltische Maschinenbau-Actien Gesellschaft, and the Aschersleben Maschinenbau-Actien Gesellschaft, the latter firm having installed a 1,000 horse-power twin-cylinder engine of this type directly coupled to an alternating current generator in the power-house of the Ilseder Hutte in Gross-Illsede, near Pein, as well as a 1,000 horse-power twin Oechelhauser engine for operating the rolling mill of the Deutsch-Luxemburgische Bergwerks-u. Hutten-Actien Gesellschaft in Differdingen, together with a 1,500 horse-power twin-blowing engine at Laar, near Ruhrort, at the power plant of the Phoenix Actien Gesellschaft fur Bergbau und Hutten Betrieb.



Five Hundred Horse-power Oeschelhoeuser Blowing Gas Engine, Constructed by the Aschersleheuer Maschinenbau Aketien Gesellschaft.

The double-acting two-cycle engines are well represented by the Koerting types, installed largely in German steel plants, as well as in the largest gas engine steel plant power-house in the world at Buffalo at the Lackawanna