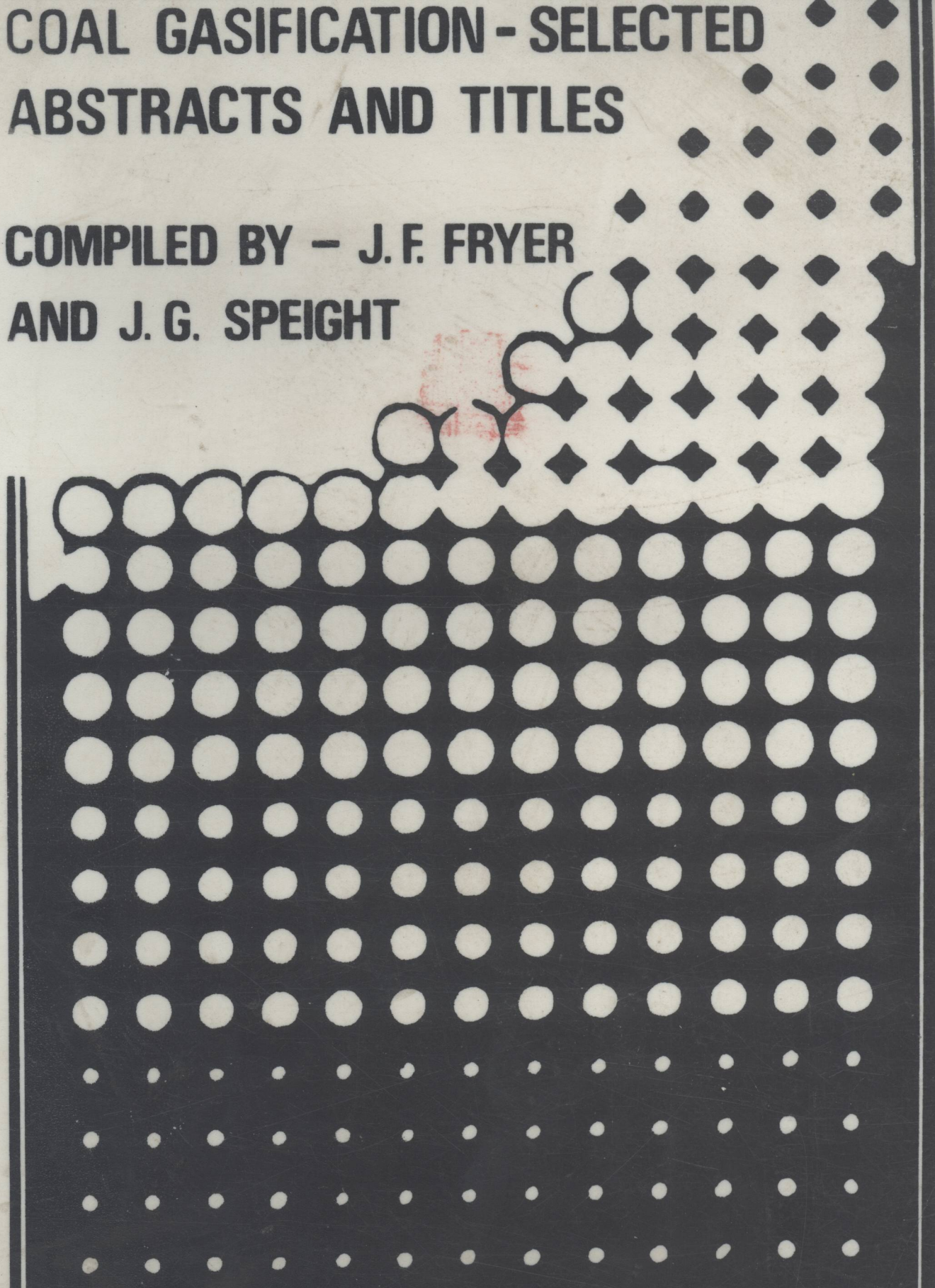
COAL GASIFICATION - SELECTED ABSTRACTS AND TITLES

COMPILED BY – J. F. FRYER
AND J. G. SPEIGHT



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FOREWORD

Recent "energy crises", concerns over secure future supplies of gaseous and liquid fuels, and greater recognition of the abundance of coal in North America are serving to direct increasing attention to the gasification of coal. Technology for producing a variety of fuel gases as well as feedstock for petrochemical operations, including production of synthetic liquid hydrocarbons, is for the most part well established through commercial coal gasification schemes in other countries. Indeed, the events of the past three or four years are now beginning to make similar schemes economically feasible in Canada and the United States.

Real difficulties are, however, commonly experienced in gaining access to much of the voluminous scientific and technical literature on coal gasification - especially material published before 1971. This material is not usually encompassed by currently active information services. We have therefore thought it timely to compile a collection of abstracts covering the period to 1970, and present it with the hope that it will assist individuals and agencies with active or developing interests in coal gasification.

The work is divided into three volumes. Volume 1 deals with gasification of unmined coal, i.e. in situ gasification. Volume 2 contains abstracts of literature pertaining to gasification of mined coal. Volume 3 concerns itself with gasification of peat, lignite and carbonaceous solids not classifiable as coals.

We are indebted to Dr. N. Berkowitz, Head of the Fuel Sciences Division of the Alberta Research Council, for his advice and encouragement throughout the preparation of this work.

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VOLUME 2

CATION OF MINED COAL

PART II : GENERAL PROCESSING, 1931-1950

0717

BROWN-COAL GAS. THE KASSEL PARALLEL CARBONIZATION PROCESS
W. Allner
Gas u. Wasserfach 74, 305 (1931)

This process consists in the low-temperature carbonization of brown coal in continuous or semi-continuous vertical chamber ovens heated with producer gas, and in passing the resulting gas and tar vapors through the hot coke, thus cracking them to such an extent that a gas of about 450 B.t.u. per cu. ft. is obtained. The tar and other by-products are similar to those from high-temperature distillation processes. The gases have a high benzene content (equivalent to 29-42 lbs. per net ton of coal). The gas liquor differs from normal coal-gas liquor mainly in its greater dilution. The coke properties depend on those of the raw brown coal, which should not decompose in the oven to such an extent as to prevent the passage of the tar and gas vapors. The resulting gases must be scrubbed to remove part of the 12-19% carbon dioxide. This is ordinarily done by means of an alkaline carbonate solution although water scrubbing might be employed where the gas is distributed at high pressures. This process may also be employed for cracking tars by filling the chamber with coke and introducing tar during the carbonization of coals giving low tar yields. Bituminous coals may also be carbonized in these ovens, but the process is especially adapted for use in those countries which have limited amounts of bituminous coal, but much brown coal.

0718

GAS PRODUCTION
C. W. Andrews
United States Patent, 1,803,686, May 5, 1931

A process of raising the calorific value of a hot gas containing a considerable proportion of carbon dioxide is described, which consists in superheating the gas by passing it through a regenerator, through a zone of coke and ash at a high temperature, then through a zone of coke at a higher temperature, and finally through a zone of bituminous coal. The passage of the gas serves to distil and to coke the coal and thereby enrich the heating gas with the distillation products, and also agitates the hot coke zone.

0719

PRODUCER GAS
C. W. Andrews
United States Patent, 1,814,580, July 14, 1931

In producer gas manufacture, there are admitted mixtures of air and carbon dioxide-containing gases capable of forming more combustible gases through endothermic reactions in a highly heated deep bed of fuel. The gases are admitted alternately from the top and bottom of a gas producer, and the periods of alternation are so timed that the sensible heat of the out-going gases is largely transferred to the in-coming gases. Ashes and clinkers which form are continuously broken up and removed. An apparatus is described.

0720

METHOD OF MANUFACTURING MIXED WATER GAS AND OIL GAS
C. W. Andrews and H. A. Brassert
United States Patent, 1,821,050, September 1, 1931

A method is described for the manufacture of mixed water gas and oil gas, which involves utilizing several generators having solid fuel beds and agitating the fuel bed in one generator and making water gas therein. Liquid hydrocarbons are gasified in a second generator and the gasified liquid hydrocarbons are carried out with the gas made in the second generator. The gases made in the first and second generators are mixed and then passed directly through a superheater to fix the volatiles therein.

0721

SULPHUR COMPOUNDS IN WATER GAS AND THEIR REMOVAL
W. E. Bakes, J. G. King and F. S. Sinnatt
Dept. Sci. Ind. Research, Fuel Research, Tech. Paper No. 31 (1931)

Water gas made from a low-sulphur coke contained 20.07 gr. of sulphur per 100 cu. ft. of gas, present in the following forms: hydrogen sulphide 14.2 gr., carbon disulphide 1.2 gr., carbonyl sulphide 2.4 gr., other forms, including probably mercaptans, 2.27 gr. Sulphur dioxide, thiophene and colloidal sulphur were probably absent. The proportion of sulphur present as hydrogen sulphide increased with the total sulphur content of the gas, in some cases reaching 90-5% of the total. Attempts were made to remove these sulphur compounds by absorption on silica gel and active carbon, respectively. The former proved unsuitable, its absorptive capacity for these compounds was low and was further decreased when the water content of the gas exceeded 10-15 gr. per 100 cu. ft. Active carbon proved to be a suitable absorbent for the purpose, removing about 95% of the sulphur in the gas, but revivification of the material at first was difficult. However, revivification was successfully effected by treatment of the spent material with steam containing a little air and ammonia at 250° for one hour. The estimated cost of the materials for purifying one million cu. ft. of gas per day, and reducing the sulphur content from 30 to 0.5 gr. per 100 cu. ft. is 0.32 pence per 1000 cu. ft. The capital and operating costs should be small.

0722

FUEL GAS
A. Breisig
Austrian Patent, 124,062, March 15, 1931

A generator for the manufacture of fuel distillation gas and water gas is described, in which the hydrocarbon vapors generated in the fuel distillation zone during the blow period are condensed by leading them through cold fuel, which is then gasified as usual.

0723

PRODUCER GAS
L. Chavanne
United States Patent, 1,799,885, April 7, 1931

In utilizing solid fuels in a slagging gas producer, the lower portion of the fuel bed is blasted with a gaseous mixture with a free oxygen content sufficiently high that fuel ashes are fused above the blasting level and maintained to a thickness not exceeding one-fourth of the total height of the fuel column, and for maintaining above this an extended zone of low-temperature distillation. An aqueous fluid is added near the top of the fusion zone, gases and entrained by-products are withdrawn, and molten products are removed from the base of the column.

0724

PROCESS FOR GASIFICATION OF SOLID FUEL
L. Chavanne
United States Patent, 1,799,886, April 7, 1931

A process of gasification of solid fuels by way of melting ashes is described, which comprises introducing the fuel lumps of the charges at the top of the fuel column, and blasting at the bottom of the column a fluid mixture containing free oxygen. A thin zone of fusion, where ashes are melted, and an extended zone of distillation at relatively low temperatures, is maintained, and fuel dust is separately introduced into the zone of fusion. The gases and products carried by the gases are collected and the molten products are removed.

0725

PRODUCER GAS
W. M. Cross
United States Patent, 1,833,964, December 1, 1931

A pulverized solid carbonaceous fuel such as coal is charged into the top of a reaction chamber into which is also simultaneously charged a preheated mixture of air and steam at a temperature such that producer gas is formed by reaction with the fuel. Producer gas is withdrawn from the bottom of the reaction chamber at a temperature of about 1200°. An apparatus is described.

0726

GAS
F. Danulat
German Patent, 556,603, March 21, 1931

Gas rich in hydrocarbons is produced by gasifying bituminous fuel while alternately blowing in steam at ordinary and raised pressures.

0727

MIXED WATER GAS AND COAL GAS
E. A. Dieterle
United States Patent, 1,792,632, February 17, 1931

A hot bed of solid carbonaceous fuel is intermittently blasted with air and steam. The steam is passed through it upwardly. Pulverized carbonaceous material is intermittently introduced above the hot fuel through a vertical retort positioned above the fuel bed. Hot gases are generated to effect distillation of the pulverized material before it encounters the hot fuel and the generated blue water gas. The resulting gases and entrained vapors are passed through vertically arranged elongated heated passages above the main fuel bed and around the retort. The apparatus is described.

0728

WATER GAS
W. J. Edmond
United States Patent, 1,799,359, April 7, 1931

In a cyclic process for the production of substantially sulphur-free water gas, fuel is subjected to alternate air and steam blows. The water gas resulting from the steam blows is desulphurised by contact with iron or iron oxide. The desulphurising material is revivified at intervals, during air blows, by contact with gases comprising, at least in part, the gaseous products of the air blows. An apparatus is described.

0729

WATER GAS
O. B. Evans
United States Patent, 1,808,214, June 2, 1931

In the production of water gas, with alternate air and steam-blasting periods, two separate fuel beds of bituminous fuel are provided in two inter-communicating water-gas generators. Hot-air blasting is effected from the top part of the fuel bed in one generator to the top portion of the other fuel bed in the second generator and from the bottom part of the fuel bed in the first generator to the bottom part of the fuel bed in the second generator. Volatile matter is evolved in the fuel bed in the first generator. Secondary air is introduced between the fuel beds to burn the volatile matter and thus facilitate the carbonization of raw fuel and store heat in the fuel bed in the second generator. This operation is followed by steam blasting to generate water gas.

0730

WATER GAS
O. B. Evans
United States Patent, 1,828,461, October 20, 1931

In making carburetted water gas, a solid fuel bed in a generator is blasted with air until a desired temperature is attained in an associated superheater and the air blasting is then automatically terminated. Steam is passed through the fuel bed, the generated water gas is carburetted until a predetermined temperature change in the superheater has taken place, and the steam run is then automatically terminated. An apparatus is described.

0731

THE INFLUENCE OF PRESSURE UPON SEVERAL CONVERSIONS OF WATER GAS
F. Fischer and H. Pichler
Brennstoff-Chem. 12, 365 (1931)

Elevated pressures hinder the gasification of carbonaceous material by steam because of the surface layer of inert gases so produced. A secondary formation of hydrocarbons results when this is prevented by using high temperatures or addition of alkali, the hydrogen already formed then reacting with carbon. The higher the partial pressure of hydrogen, the greater is the hydrocarbon formation. In the catalytic hydrogenation of carbon monoxide elevated pressure favors the formation of high molecular weight hydrocarbons upon catalyst surfaces which rapidly lessen catalyst effectiveness. Oxygen-containing products are also formed in addition to hydrocarbons. Lower pressures require greater contact surfaces for equal conversion to hydrocarbons. Pressure strongly affects the manner and rate of methane decomposition by carbon dioxide or steam. The equilibrium $CH_4 + CO_2 \rightleftarrows 2CO + 2H_2$ *is displaced completely to the right at 1 atmosphere pressure at 900° in the presence of a nickel catalyst. At 0.003 atmospheres and 400° only 50% conversion occurs while at 0.003 atmospheres and 300° only 25% occurs. Reaction rate increases proportionally with pressure decrease. Temperature and pressure dependence of the equilibrium have been determined and calculated. A literature review is appended.*

0732

EFFECT OF SODIUM CARBONATE UPON GASIFICATION OF CARBON AND PRODUCTION OF PRODUCER GAS
D.A. Fox and A. H. White
Ind. Eng. Chem. 23, 259 (1931)

Sodium carbonate reacts in appreciable measure with carbon at temperatures above 800° and the rate becomes rapid above 900°. The reactions are: $Na_2CO_3 + 2C = 3CO + 2Na$; $Na + CO_2 = NaO + CO$; $NaO + CO_2 = NaCO_3$. *The net effect is to increase the vapor pressure of carbon to the ten to fifteenth power times its actual value. The mechanism of the reaction is discussed. The use of coke impregnated with sodium carbonate in the gas producer gives gases higher in carbon monoxide than would otherwise be obtained. In a water-gas machine the gases are much richer in carbon monoxide and hydrogen, but the increased reactivity of the fuel bed would be disadvantageous during blasting and offset any gains during steaming.*

0733

PROCESS FOR THE GASIFICATION OF SOLID FUELS
M. Frankl
British Patent, 357,853, October 1, 1931

A process is described for the gasification of solid fuel by means of steam and oxygen in two gas producers connected by their lower part. Steam is introduced alternately at the upper part of each of these gas producers, passed downwards through a hot mass of solid fuel to partly gasify it, and then the resulting hot gas is passed upwards through a cold mass of solid fuel in the second gas producer to heat it by its sensible heat and by the combustion of the fuel with oxygen added at the lower portion of this producer. These operations are reversed when the first mass is sufficiently cold and the second mass sufficiently hot, and oxygen is added only after the reversal.

0734

PRODUCING COMBUSTIBLE GASES
W. Gaus and W. Wild
United States Patent, 1,801,857, April 21, 1931

The patent describes the production of combustible gas, which comprises passing a gasifying medium first around the walls of an electric arc space, through the latter thereby preheating the gas, and then through solid incandescent carbonaceous material, whereby a combustible gas is generated by gasification of the carbonaceous materials.

0735

FUEL-CHARGING APPARATUS FOR GAS GENERATORS
J. H. Gleason
United States Patent, 1,806,623, May 26, 1931

Structural features of gas generators are described.

0736

GASIFICATION OF COAL IN SMALL PRODUCERS
M. Gohin
Bull. Off. Congr. Comb. No. 7, 194 (1931)
Chimie & Industrie 27, 1065 (1931)

A discussion of the possibility and advantages of using coal-fired gas producers on automotive engines.

0737

MANUFACTURE OF CARBURETTED GAS
A. W. Grent, Jr.
United States Patent, 1,819,838, August 18, 1931

A process of manufacturing carburetted producer gas is described, which involves continuously blasting a bed of incandescent solid carbonaceous fuel with a mixture of an oxygen-containing gas and steam. A portion of the gas produced is burned, then a liquid hydrocarbon is introduced in a separate chamber to a portion of the gas. The combustion is used to furnish the heat required for the permanent volatilization of the liquid hydrocarbon and the consequent enrichment of the gas. The portion of the gas burned is sufficient so as to supply enough heat for the volatilization and enrichment.

0738

IMPROVEMENTS IN THE COMBUSTION AND GASIFICATION OF CARBONACEOUS MATERIALS AND APPARATUS THEREFOR
F. C. Greene
British Patent, 347,575, April 27, 1931

A method of producing fuel gas from coal is described, in which fresh fuel added to a mass of fuel is progressively advanced through regions wherein its temperature is progressively increased. The temperature gradient is on a plane transverse to the direction of flow of a combustion supporting gas which is passed over the hot exposed surface of the mass of fuel, without passing through the mass of fuel.

0739

IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF GAS
A. R. Griggs
British Patent, 342,958, February 12, 1931

The patent describes the manufacture of gas by a complete gasification process, in which hot gaseous fluids produced in the production of water gas from the coke are passed through coal contained in a superposed chamber or retort. Blast gas led off from the coke without passing through the coal is burnt in a recuperative chamber surrounding the coal containing chamber or retort so that heat conducted through its wall assists in carbonizing the contained coal. Steam is superheated by its passage through the recuperative chamber in counter-current direction, and is then passed upwardly through the coke for the production of water gas which is passed upwardly through the superposed chamber or retort to assist in carbonising the contained coal.

0740

ENRICHED WATER GAS
A. R. Griggs
British Patent, 377,492, September 17, 1931

In a complete gasification process, in which blast gases emerge from the marginal surface of the coke at the junction of a water-gas generator and carbonizing zone, while the gases from an up-run pass through the coke and coal without passing through this surface, the gas is enriched by injecting tar through tangential nozzles onto the surface and into the coke so that carbon is deposited and tar vapors are cracked in the presence of hot water gas and excess steam.

0741

ENRICHED WATER GAS
A. R. Griggs
British Patent, 377,819, August 7, 1931

In the manufacture of enriched water gas by spraying tar onto the hot marginal portion of the fuel bed after upwardly blasting with air and following by a down run, the marginal portion of the fuel bed attains a sufficiently high temperature without burning the blast gases in the generator top. The tar spraying may be during the down-run and also during a preliminary up-run immediately after the "blow".

0742

IMPROVED PROCESS FOR THE PRODUCTION OF A MIXED GAS CONTAINING CARBON MONOXIDE AND HYDROGEN
A. G. Rheinland
British Patent, 343,160, February 16, 1931

A process is described for producing a mixed gas containing carbon monoxide and hydrogen from coke or other carbonaceous substances and water or water vapour, in which the mixed gas is produced by subjecting a column of the carbonaceous material to luminous discharges in an electric field produced between the poles of a generator of high frequency current of high tension.

0743

ROTARY GRATE FOR PRODUCERS FOR GASIFYING FINELY GRANULAR FUEL
H. Hebel
Austrian Patent, 126,594, September 15, 1931

0744

GAS PRODUCER
A. P. van Heeden
United States Patent, 1,810,738, June 16, 1931

Various structural details are described.

0745

DIRECT PRODUCTION OF GAS FREE FROM TAR
J. van Hemelryck
Belgian Patent, 378,998, May 31, 1931

The air is introduced into the burning fuel at a temperature as close as possible to that of the fuel, and in no case lower than 1000°. This temperature is obtained by utilizing the heat of the wall of the tuyere, and a sufficient amount of air is discharged outside to prevent the tuyere from being heated to its melting point.

0746

UTILIZING COAL DEPOSITS
A. Hiorth
Norwegian Patent, 49,960, December 28, 1931

Coal is burned incompletely in situ and the gases are conducted from the mine and burned completely to produce heat for a variety of uses.

0747

COMBUSTIBLE GAS CONTAINING HYDROGEN AND CARBON MONOXIDE
H. A. Humphrey
United States Patent, 1,794,232, February 24, 1931

In a continuous gas producing process a mixture comprising steam and oxygen preheated to above 1000°, is passed into and through a gasification chamber and finely divided solid fuel is fed into the chamber to contact and react with the preheated mixture and to generate gas at such a high temperature that carbon monoxide and hydrogen almost free from methane or other hydrocarbons and carbon dioxide are produced. The hot generated gas is led into and through a second preheating stage and from the latter combustible gas is withdrawn. A reversal of flow of the mixture containing steam and oxygen is effected whenever its temperature immediately prior to its contact with the fuel tends to fall materially below 1000° and (irrespective of the direction of gas flow) the particles of solid fuel are maintained in suspension in a relatively large mass of enveloping gas in the reaction chamber. The apparatus is described.

0748

GASIFICATION
J. J. Humphreys
Proc. Symposium Fuel Coal, McGill Univ. 73 (1931)

A short history of the gas industry with illustrations of typical gas generators and retorts.

0749

GAS
Humphreys & Glasgow Ltd.
French Patent, 716,343, April 30, 1931

A gas rich in hydrogen is obtained by periodically blowing air into a mass of burning fuel, controlling the temperature of the fuel and passing hydrocarbon gases through the mass to transform them to carbon, hydrogen and methane. The temperature of the fuel is controlled so that the methane in the hydrocarbon gases as well as that formed by the decomposition of the higher hydrocarbons is decomposed by contact with the surface of the fuel rather than in the mass of gas and that practically the whole of the carbon liberated is retained on the surface of the fuel to be utilized later.

0750

GAS
Humphreys & Glasgow Ltd.
French Patent, 716775, May 8, 1931

Water gas and coal gas are made by a complete gasification process in an apparatus comprising a gasification chamber, carbonizing chamber and superheating chamber. Steam is injected into the superheater to circulate through the three chambers and ensure sufficient heating of the coal in the carbonizing chamber.

0751

WATER GAS
Humphreys & Glasgow Ltd.
French Patent, 723,109, August 29, 1931

Air is blown into a mass of fuel in a generator, the gases thus produced are burned with secondary air in contact with the greater part of the fuel, the heat of their combustion is stored partly in the generator and partly in a carburetion apparatus, and steam and hydrocarbon are sent through the mass of fuel, producing blue water gas and dissociating the hydrocarbon.