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WATER OR PRODUCER GAS, APPLIED TO THE ARTS OF MANUFACTURE.

BY JOHN FELL.

The subject of this paper is not the birth of a new idea, but the resurrection of an old process. It has been the dream of scientists for years to discover a process for utilising the full calorific value contained in any form of fuel. Their researches were fraught with many difficulties until about the year 1860, when a Frenchman named Gillard successfully lighted the town of Narbonne, in France, with water gas, using an argand burner, surmounted by a platinum wire cage extending above the flame. When the cage became incandescent it yielded an intense white light; but, owing to the great cost of platinum and expense of manufacture, the scheme was not a commercial success. Gillard's process of production was identical with the method of to-day, only that he failed in not going far enough by purifying the gas. He employed a cupola filled with coke, the fuel was ignited and brought to a state of incandescence by a fan, all connections with the atmosphere were closed, and the fan stopped. The steam was then admitted below the grate, and in passing through the incandescent mass was decomposed, the resulting gas being drawn by an exhauster from the upper part of the cupola. When the heat fell the steam was turned off and the fan again applied. His process being intermittant largely tended to failure. Had he kept the fan going and scrubbed the gas, his labors of 40 years ago would have been amply rewarded. It is surprising that so small a defect escaped

his notice, as at that date his process was supported by the best English chemists and ablest gas engineers. The hydrocarbon process, as it was called, was installed at Rutline, Southport, Warminster, Dunkeld, Manchester, Greenock, and the South Metropolitan Gas Works, as a substitute for the ordinary method of manufacturing coal gas.

For various reasons it turned out a failure. The zeal and perseverance displayed in trying to perfect the process deserved better results; but coincidences do happen, and to-day we find this process in an improved form is employed at nearly all the large gas and iron works of Great Britain, America and the Continent.

Many other exploiters followed in the wake of Gillard until the labors of Mr. I. E. Dowson made the process continuous, and have to-day operating on the markets of the world the following systems, namely, the "Dowson," "Mond," "Korting," "Lencauchez," "Deutz," &c.

In order to explain this system the author will briefly describe a Dowson plant. (Plate III). The Producer is cylindrical in form with inspection doors having an inner shell lined with fire bricks, covered at top, from which cover hangs the producer bell, and attached to the top of cover are the gas outlets and charging hoppers, sealed at the bottom with a water lute, in which is supported the revolving fire grate on a cylindrical air lute, which directs the blast in communication with the annular space between the two shells of the producer. Attached and in direct connection to the outer shell, are three water syphons for excess saturation. The gas main leading from the top of the Producer is coupled to a vertical jacketed cylinder, called a combined saturator and Condenser, which rests on the hydraulic box on which also rests the cylindrical coke scrubber, having a grating, closed at the top in which hangs a water spray, the gas outlet branches at top and leads to the tar extractor which is in form much like a centrifugal pump having a cast-iron frame with side inlet and outlets, the

disc is steel with tapered vanes riveted vertically from centre, the whole carried on a spindle passing through stuffing glands to the driving pulley; attached to the gas inlet side, is a water syphon and at base is the water and tar outlet. A rising main connect the extractor with the purifiers which are also cylindrical, having a series of gratings on which rests the purifying agent, manhole charging and cleaning doors are formed to every series of gratings, and coupled to the purifiers is the gas main leading to the furnace or engine.

DOWSON'S PROCESS OF MANUFACTURE.—When about to start work water is passed into the Producer lute until sealed, then the scrubber shower is started, and the plug on the ascension tee-piece removed. A fire is lighted in the Producer, and fuel fed through the hoppers until full, the blast fan then being started causes a current of air to pass round the top portion of the saturator and water-jacket, where it absorbs steam given off (due to the hot gas passing down the inner cylinder), thence it passes into the producer air-jacket, where it is further impregnated (if required) with the water drip lutes. In its passage round this annular space it becomes superheated from radiated heat, passing through the fire-brick lining. and thence passes out by a bend and tee-piece leading to the cylindrical air lute supporting the revolving fire grate. The superheated air and steam are forced through the grate and fuel at a pressure of about 5in., and become converted into gas, when the temperature reaches about 2200deg. Fah. The gas then passes up the bell, which defines the depth of active combustion, and to a certain extent cools the hot gas by the cold mass of fuel surrounding. Gas is then forced down the inner cylinder of the saturator and condenser, where a large percentage of its heat is abstracted by the gas coming in contact with the water-cooled wall, and depositing any free carbon and tarry matter in suspension, the gas bubbles under the hydraulic seal, thence up through the coke scrubber, which is filled with small coke saturated with water from the shower. Here the gas

should deposit any fine particles of impurities, filtering through the cold mass, provided the area is sufficient; thence it passes to the tar extractor, which is revolving at a speed of 1200 per minute, meeting a water jet which is fed through the gas inlet by the syphon to the revolving disc, producing a fine spray, washing the gas passing to the purifiers, which have a layer of sawdust on the grids. Here the gas goes through its last process of filtering, when it should pass away pure for consumption.

The MOND PRODUCER is very similar in construction, but the purifying is much more complete, and embraces a recovery plant for sulphate of ammonia. This process is clearly described by Mr. Humphrey in a paper read before the Institute of Mechanical Engineers, 14th December, 1900, to which the author would refer those interested. It would suffice to say that the ordinary type of Mond Producers at Winnington are each capable of gasifying 20 to 24 tons of slack per day of 24 hours, which showed the immensity of the plant, considering the volume of gas made from one ton of fuel varied from 140,000 to 160,000 cubic feet, according to the quality of the slack.

In the first part the author drew particular attention to the failure associated with Gillard's process, in neglecting to purify the gas, and it is at the present time the all important question, for dirty gas, like wet steam, gives constant trouble to the gas engineer, who often times blames the quality of the lubricant, when the reason is not far to discover—"imperfect combustion or dirty gas." It is easy to make water gas for furnace or smelting purposes, where the vapors are taken direct from the producer without purifying, but for gas engine use it must be pure as city gas, and of a standard quality, otherwise the efficiency is lowered, just as the varying pressure of a steam boiler.

The gas plant being of simple design does not require more skilled labor than the ordinary fireman. It instantly responds to fluctuations, there is no loss due to condensation or leaky

joints, it can be closed down and left with fire in it for over a week, and be ready to start at short notice, while the maintenance and repairs are much less than with a steam boiler. As we have not had sufficient experience in the working of the Producer Gas Plants in these States to make comparisons, the author would like to refer members to a paper read by Mr. Dowson, before the Institute of E. Eng., London, vol. 33, part 2, issued April, 1904, which contains much of interest to engineers and users of fuel searching for economy.

“Consumption of fuel in stand-by hours.—The average of four installations having a producer capacity of 250 H.P. gives a consumpt. of 3lb. per hour, whereas under steam boilers of 210 H.P. require 67lb. to maintain the pressure.

“Water consumption is rated at one gallon per B.H.P. per hour.

“Fuel consumption.—Small coal per B.H.P. per hour, 1·26lb.; anthracite, 1·36lb.; gas coke, 1·60lb.

“Calorific value.—Water gas, 173 B.T.U. per cubic foot; coal gas, 691 B.T.U.”

From the figures given by Dowson it will be seen that the heat value is about four times poorer, but as one volume of gas requires for perfect combustion 1.15 volumes of air against coal gas requiring 5 volumes. For example, 1000 cubic feet coal gas diluted with 5000 cubic feet air makes 6000 cubic feet of highly explosive mixtures; it will take 2800 cubic feet of producer gas diluted with 3200 cubic feet of air for the same explosive value.

The cost of energy, including fuel, labor, oil, stores, repairs, maintenance and superintendance works out about 0.94 penny per unit, or 0.29 of a penny per E.H.P. hour for an electrolytic plant of 5000 horse power, running night and day.

At Messrs. Lysaght Bros.' Wire Netting Works, Chiswick, a Dowson Gas Plant is producing gas for 79 E.H.P. gas engines at a cost of 1.93 pence per 1000 cubic feet. Prior to the erection of this plant City gas cost 3/- per 1000 cubic feet.

It is needless to say the saving is considerable. This plant runs night and day, and has been working the past seven months.

Producer Gas can be, and is, used in all branches of manufacture where heat and force is required. It fills the place of all other fuels for smelting, producing little oxidation, which gives purer metals than obtained by other methods, and where the value of coal or wood is considerable (for gas can be as readily made from the latter as the former). It is paramount that many of our low grade ores could be successfully treated.

It is also used for lighting with the aid of the incandescent mantle and for domestic purposes.

The gas can be produced from any substance that will ignite. Its limit of use is unbounded, owing to the cheapness of production, and will be the means of popularising and improving the internal combustion engine, which is destined to rank as the first distributor of power.

The author is of opinion that water or Producer Gas can be successfully and economically applied for generating heat in any type of existing boiler. For marine work it is highly applicable, cleaning tubes, combustion chambers and fires would be things of the past, and another point in its favour, forcing boilers to their maximum could be resorted to.

A Producer 4 feet in diameter by 8 feet high gives an efficiency of 250 B.H.P. These measurements will give some idea of its producing capacity, and also the space occupied as compared to a steam boiler of equal power.

The internal combustion engine having a series of cylinders coupled to one shaft, operated by water gas, would be believed, in the near future claim greater advantages for marine, or in fact all classes of work, than the steam engine.
