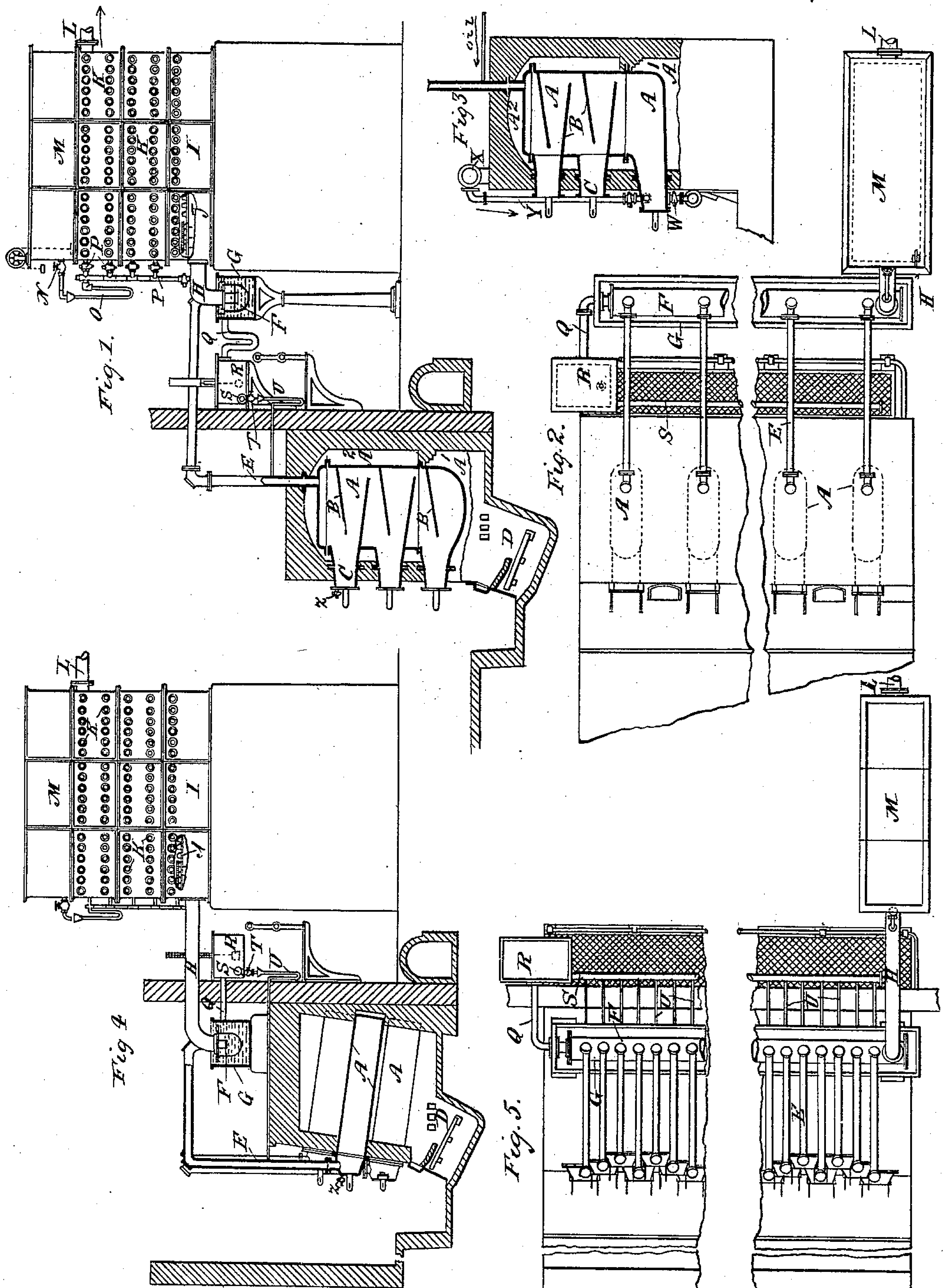
(No Model.)

W. YOUNG & A. BELL.

APPARATUS FOR PRODUCING ILLUMINATING GAS.

No. 540,415. Patented June 4, 1895.



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UNITED STATES PATENT OFFICE.

WILLIAM YOUNG AND ALEXANDER BELL, OF PEEBLES, SCOTLAND.

APPARATUS FOR PRODUCING ILLUMINATING-GAS.

SPECIFICATION forming part of Letters Patent No. 540,415, dated June 4, 1895.

Application filed May 5, 1893. Serial No. 473,110. (No model.) Patented in England July 5, 1892, No. 12,421.

To all whom it may concern:

Be it known that we, WILLIAM YOUNG, consulting chemist, and ALEXANDER BELL, gas-works manager, of Peebles, in the county of Peebles, Scotland, citizens of the United Kingdom of Great Britain and Ireland, have invented new and useful Apparatus for the Decomposition of Mineral Oils for Producing Illuminating-Gas, (which have been patented in Great Britain by Letters Patent dated July 5, 1892, No. 12,421;) and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art or manufacture to which it relates to make and use the same.

Our invention has for its object to increase the amount of light obtained from a given quantity of mineral oil when such oil is decomposed by heat in order to produce illuminating gas and it consists of an improved apparatus for decomposing the oil.

Our invention may be put into practice with various forms or constructions of apparatus and on the accompanying sheet of drawings we have shown several suitable constructions.

Figures 1 and 2 are respectively a vertical section and plan of one arrangement suitable for the purpose of carrying out our process and in which the decomposing vessels or retorts are placed vertically and provided with shelves, Fig. 3 being a modification. Figs. 4 and 5 are respectively a vertical section and plan, also partly in section, of a further arrangement wherein slightly-inclined retorts are employed.

In the modification shown at Figs. 1, 2, and 3 of the drawings the retorts A are of round ended oblong cross section made of cast iron or steel and are placed vertically and provided with shelves B and openings C having the usual retort lids to enable the carbon or coke resulting from the decomposition of the oil to be removed from the shelves and bottom of the retorts. These retorts are shown as being heated by means of a special furnace with fire bars D but where water gas is being produced to be enriched by oil gas, the producer gas resulting from the blowing up of the generator may be conveniently employed to heat the retorts to the necessary temperature, or where the process of producing ordinary coal gas is carried on in conjunction with the manufacture of oil gas, the heating of the oil gas retorts may be effected by the waste heat from the coal gas retorts. The retorts are preferably heated highest at the lower parts which can be conveniently done by carrying the fire gases along and around the bottom parts A′ first and subsequently up and around the upper part A^2.

The stand pipes E convey the products resulting from the decomposition of the oil in the retorts to the hydraulic main F which is kept cool by immersion in water contained in the tank G.

The main pipe H conveys the products (volatile and gaseous) from the hydraulic main to the combined condenser and washer I. This part of the apparatus consists of a rectangular vessel containing a series of shelves provided with short tubular nozzles covered by light sheet iron covers to cause the products passing through it to bubble through and come into intimate contact with the fluid contained in the shelves. Part of a shelf is shown at J.

In order to cool the products there are inserted between the shelves the tubes K passing from side to side of the vessel so that air can pass freely through them. The permanently gaseous products pass away by the main pipe L.

On the top of the condenser and washer is placed the tank M to contain the oil to be decomposed. This tank should be provided with a float to indicate its contents. The oil to be decomposed is allowed to flow out of the tank into the arrangement by means of the regulating valves N into the filler attached to the tube O. This tube is connected by branch pipes provided with stop cocks P to each of the shelves in the condenser and scrubber and also to the pipe H leading from the hydraulic main, so that the oil can be made to flow through all or any number of the shelves forming the washing arrangement or the oil may be allowed to flow direct into the hydraulic main, without passing through the washer according to the amount of washing it is desired to subject the gaseous products from the oil. The oil entering the hydraulic main F at the end from which the decomposed products from the retorts leave, flows through its whole length and is withdrawn at the opposite end by the pipe Q into the cistern R provided with a float and indicator to show it contents. The oil flows from the cistern by the main pipe S provided with the regulating valves T to regulate the flow of oil through the siphon pipes U into and down the stand pipes E onto the upper shelves of the retorts.

To carry out the process the apparatus is operated in the following manner: The tank M having received a charge of oil and the retorts being heated to the desired temperature; the regulating valve N is at first fully opened and the oil flows through the tube O on to the lower shelf of the condenser and washer until the bottom part of the condenser and the hydraulic main F is filled up and the oil has overflowed by pipe Q and partially filled the compensating cistern R. The regulating valve N is then checked to pass about the quantity it is anticipated the retorts will decompose. We have found 1,050° to 1,150° Fahrenheit to be a suitable external temperature to begin with. Different oils however require diferent temperatures and the effect of externally applied temperatures can be considerably modified by the rate at which the oil is run into the retort, a large flow of oil lowering the internal temperature of the retort or keeping the internal temperature at that suitable for the purpose, although the external temperature is raised. An increased external temperature with proportionally increased flow of oil into the retort leads to a larger product of gases per retort. The oil is now allowed to flow from the cistern R through the pipes S and regulating valves T and the siphon pipes U into and down the stand pipes E on the upper or first shelf in the retort. The rate at which the oil is allowed to flow into the retort must be largely in excess of that which the heat of the retort will decompose into permanently gaseous compounds. At least one half of the total oil must leave the retort in a condensable form and with most oils, especially oils of high gravity, the best results will be obtained when only from one fourth to a sixth of the oil passing into the retort is decomposed into permanently gaseous compounds, the three-fourths to five-sixths leaving the retort as vapor only partially decomposed or being left in the retort as solid carbon.

The proper quantity of oil to be run into the retort in relation to the externally applied temperature, is readily ascertained by the appearance of the partially decomposed products, when a portion is allowed to escape by the small stop cock Z fixed in the retort door. The products should have the appearance of oil vapor, being whitish or pale to at most dark yellow. When the supply of oil is too small in relation to the temperature of the heat applied to the retort the vapor becomes more or less dark brown in color. Such a condition is detrimental to the success of the process. This large flow of oil falling upon the first inclined shelf B runs down it and thence from shelf to shelf to the bottom of the retort, being exposed in its descending course to the heat radiated from the walls of the retort and as mineral oils consist of a series of hydrocarbons of different boiling points which the fractional process of decomposing accentuates, on the resulting products getting into circulation these different grades are volatilized as they in their descent over the shelves in the retort reach their boiling points at distances from the outlet of the retort which increase as the boiling points rise. Thus the vapors into which the oils are successively converted and each of which is in its turn less easy to decompose, are subjected to corresponding higher temperatures and longer periods of time. The products resulting from this fractional decomposing treatment of the oil pass up the stand pipe E when they are met and partially washed of the grossest matter by oil admitted by the pipe U and flowing down the stand pipe to the retort. The condensation and absorption of most of the oil vapors which have only been partially decomposed on their first exposure to the heat of the retort takes place while bubbling through the oil in the hydraulic main. The great heat resulting from this condensation is rapidly transmitted through the walls of the hydraulic main to the surrounding water contained in the cistern.

The more volatile products together with the gaseous portion pass by the pipe H from the hydraulic main to the condenser and washer I when the cooling and washing of the gaseous portion is completed.

For a time the oil flowing over the single lower shelf of the washer is capable of absorbing the vapors out of the gases, but as the process continues and the apparatus and the oils get heated, the oil has to be admitted into the condenser and washer on the higher shelves, so that it may flow down from shelf to shelf and present a greater surface to more perfectly fractionate out of the truly gaseous portion that which would otherwise condense.

The number of shelves over which it is necessary to pass the oil so as to sufficiently absorb and fractionate out of the gaseous portion the volatile hydrocarbons which would otherwise condense is dependent upon the nature of the oil employed. Oils containing volatile matter have less solvent power than heavy dead oils. The solvent power of the oils diminishes as the temperature rises, and the number of shelves through which the oil is run must be regulated accordingly.

The purpose to which the oil gas is to be applied has also to be taken into consideration in connection with the washing with oil. When the oil gas is to be used to carburet and give illuminating power to water gas or to increase the illuminating power of coal gas, hydrocarbons which would condense out of the oil gas if kept separate would be rendered perfectly permanent when diffused through those gases and therefore for such a purpose less oil washing is required. Indeed sufficient washing, or scrubbing may for such purposes be obtained by the portion of the oil which escapes decomposition in the retort but which in a volatilized state passes off with the gases falling or dropping back through the gases rising from the retort and in that case it is not necessary to pass the crude mineral oil through the water at all it being supplied direct to the retorts by a separate supply pipe connected to the supply cistern. On the other hand when the oil gas is to be used for lighting railway carriages and requires to be stored under considerable pressure, then the washing of the oil gases require to be more drastic so as to render the oil gas as free as possible from hydrocarbon which would condense during compression.

The proper amount of oil washing is readily ascertained by the illuminating power and character of the gas and the proper quantity of oil flowing into the arrangement from the supply tank M through the regulating valve N is indicated by the float in the compensating cistern R. If the supply is in excess of that which is being decomposed in the retorts the indicating float rises and falls when the supply is deficient.

The oil after having undergone one decomposition in the retort, and has had a portion rendered permanently gaseous which passes away by the pipe L to the purifiers, the partially decomposed portion condensed and absorbed by the fresh oil flows back through the arrangement to the compensating cistern R and the commingled oil and partially decomposed products are again submitted to a second decomposition in the retort and the resulting products again condensed and washed as already described. The process of alternate decomposition and condensation and washing is thus continued with the result that the stream of oil flowing into the arrangement is completely split up into permanently gaseous compounds which leave the arrangement by the pipe L and carbon which is left upon the shelves and bottom of the retort as hard coke. This coke is periodically removed when it accumulates so as to begin to interfere with the process.

Fig. 3 shows a modified form of retort by which instead of reducing the residue of the oil to coke in the bottom of the retort, it may be decomposed only to such an extent as to allow of it being drawn off by the stop cock W in a state which on cooling becomes pitch. In working by this modified form the flow of oil into the retort must be increased or the temperature of the retort kept a little lower than when coke is produced.

Fig. 3 also shows how a poor gas such as that obtained from the decomposition of water may be employed, the poor gas being supplied from the gas main X and branch pipe Y into the bottom of the retort. By this arrangement the oils are decomposed in the presence of the poor gas. We believe however, that except with special oils better results are obtained by decomposing the oils and producing the water or other poor gas separately and commingling them after they are comparatively cold as a much better fractionation of the products from the oil can be made than when the water gas is present. The water gas is also much easier treated during the process of cooling enabling water to be more freely employed as the cooling agent.

The arrangement of apparatus shown by Figs. 4 and 5 are substantially identical in every respect with the arrangement shown by Figs. 1 and 2 and is in every respect operated in the same manner the only essential difference being in the form of the retorts which are placed at a slight inclination from the horizontal and contain no shelves. The decomposition of the oil is however effected in a similar manner the oil falling from the stand pipe on to the bottom of the inclined retort flows down to the opposite end, volatilizing as the temperature rises in the graded manner corresponding to that described where the oils flow over the shelves in the vertical retort.

In decomposing the oils in slightly inclined retorts we do not find it of importance to differentiate the heat applied externally to the retort between the higher and lower end as the oil entering the higher end rapidly reduces the temperature to that suitable for the process.

Our process may in part be carried into effect in many of the existing forms of apparatus both in which oil gas is produced alone, and also in those in which oil gas is produced by decomposing oil in the presence of poor gas from coal or in the presence of water gas in retorts or in decomposing vessels heated internally.

In producing gas from oil by such existing arrangements in accordance with our invention, the temperature at which the oil is decomposed is reduced by adjusting the inflow of oil to the temperature of the decomposing vessel (the higher the temperature of the decomposing vessel the larger must be the flow of oil) so that only a fractional part of the oil is decomposed each time it passes into the retort or decomposing vessel, and the oil and condensed undecomposed products are employed to wash the gas and carry back into the decomposing vessel the undecomposed portion of the oily products for further decomposition.

When our invention is practiced in conjunction with the manufacture of water gas and when the mineral oils to be decomposed are very crude and tarry, containing a large excess of carbon in their composition, the water gas plant should in order to carry out the process be so constructed that the oil and returned undecomposed products shall flow, or be pumped back, into the water gas producer, so that the excess of carbon may be there deposited as solid carbon to be utilized in the reheating of the upper internal walls of the decomposing chamber or in the production of water gas. In decomposing such tarry mineral oils in externally heated retorts we have found that ordinary fire brick retorts may be employed, and that the process may be conducted in conjunction with the production of gas from coal.

Having thus particularly described our said invention and arrangement of apparatus whereby the same may be carried into practical effect we wish to state that we do not restrict ourselves to the precise details therein described and delineated as the like results may be obtained by many other modified arrangements. We also wish to state that we are aware that in the manufacture of oil gas the tar and oil which has unavoidably escaped decomposition, when the oil has been distilled at a comparatively high temperature has been returned with the fresh oil into the retort to there undergo further decomposition. We are also aware that it has been proposed to wash oil gas with oil, and that oil has been extensively used to wash the hydrocarbons out of gas produced in shale oil works, and benzole out of gases produced from coal and therefore we desire to restrict our claim accordingly.

We claim—

In combination with a retort having an inclined heating surface, external heating means, an oil supply for said retort, a discharge for the gaseous products, a scrubber with an oil inlet at one end and a gas inlet at the other, and a discharge pipe from said scrubber for the fresh oil and imperfectly decomposed products washed from the gas by the fresh oil leading to the retort, substantially as described.

In witness whereof we have hereunto set our hands and seals the 31st day of January, 1893.

WILLIAM YOUNG. [L. S.]
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