L. L. SUMMERS.

PROCESS OF MAKING ILLUMINATING GAS.

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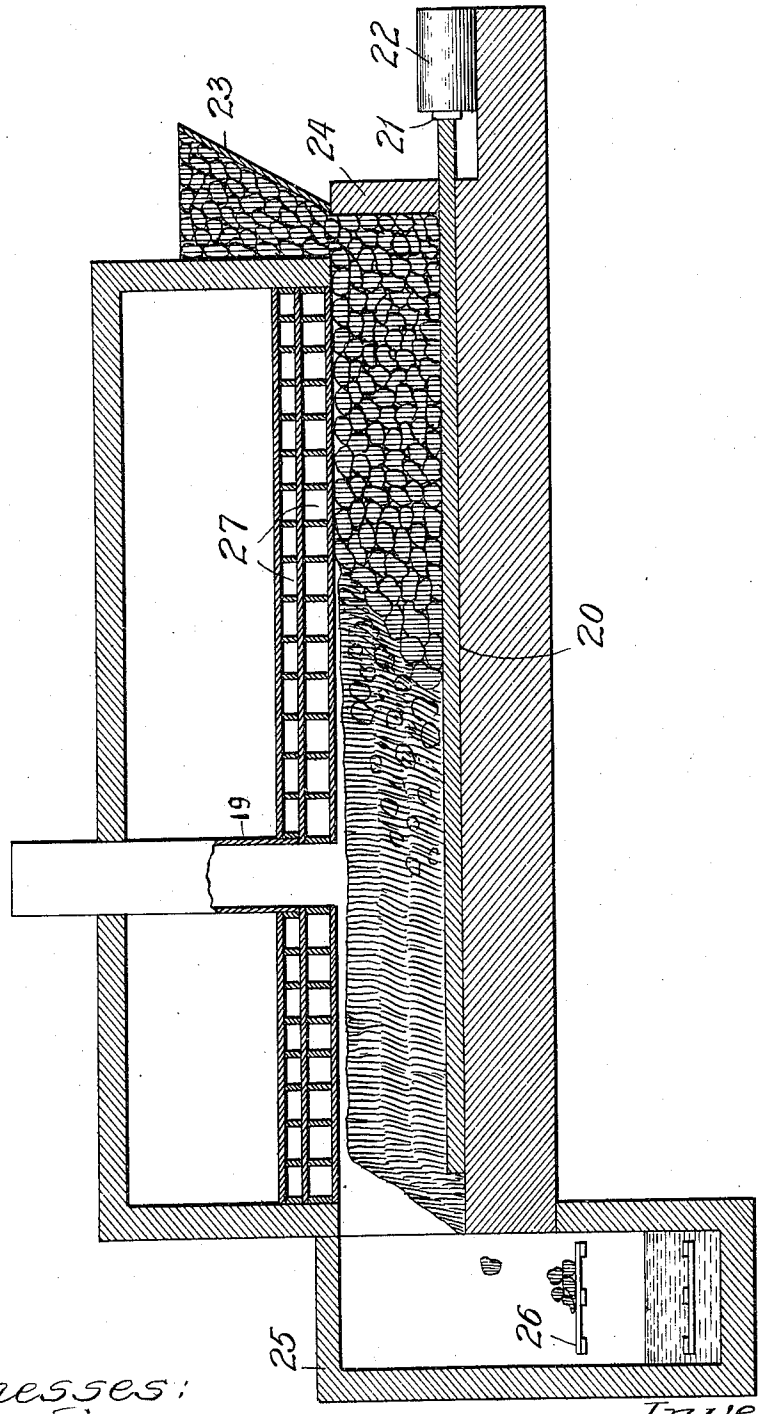
1,023,446. Patented Apr. 16, 1912.



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UNITED STATES PATENT OFFICE.

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PROCESS OF MAKING ILLUMINATING-GAS.

1,023,446. Specification of Letters Patent. Patented Apr. 16, 1912.

Application filed December 22, 1911. Serial No. 667,325.

To all whom it may concern:

Be it known that I, LELAND L. SUMMERS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Processes of Making Illuminating-Gas, of which the following is a specification.

The object of my invention is to provide an improved process of enriching and purifying illuminating gas, and among other features to provide a means for increasing the value of the by-products.

In a coking process patented by me under date of November 18th, 1910, Patent No. 951,786, I have described a process of producing coke in which process the hydrocarbons distilled from the coal are forced to pass through highly heated carbonaceous material having a temperature sufficiently high to decompose the hydrocarbons.

In the present process I introduce into a body of carbonaceous material a hydrocarbon, such as tar, benzol, or petroleum, capable of destructive distillation and heat the mixture so formed as in the coking process referred to, causing the products of this destructive distillation both of the carbonaceous material and of the hydrocarbons to pass simultaneously toward the source of heat whereby the products of the distillation from the carbonaceous material which are volatilized at the higher temperature are intimately mingled with the products from the distillation of the hydrocarbons, which are volatilized at the lower temperature, as they are disassociated by traveling toward the source of heat thereby causing reactions between the gases to take place. Thus combinations are formed whereby the gas can be purified.

In a patent issued to me under date of August 23rd, 1910, Patent No. 968,499, I have described a process for eliminating sulfur from carbonaceous material in which I first cause the mode of occurrence of the sulfur in the carbonaceous material to be changed so that the sulfur may be readily volatilized and then cause the sulfur to be volatilized in a coking oven. In this volatilizing the sulfur in order to free the coke from impurities, the gas, as distilled from the coal, is charged with the volatilized sulfur and is thus loaded with undesirable impurities. I have discovered that by causing this volatilized sulfur to travel toward the source of heat and by mingling it with decomposing hydrocarbons simultaneously traveling toward the source of heat the sulfur and hydrogen are made to react, and that compounds are formed whereby the sulfur can be readily treated in the condensing apparatus and thus remove this impurity from the gas. I have further discovered that by disassociating the hydrogen and carbon from the hydrocarbon and causing this carbon and hydrogen to be liberated in the presence of the nitrogen evolved from the coal, as the products are disassociated, reactions take place by which an increased yield of valuable by-products may be obtained, such as ammonia NH_3, cyanids, such as sulfo-cyanid CNS and various other compounds of cyanogen and ammonia.

In the practice of my invention I preferably use a form of furnace such as shown in my Patent No. 951,786 before referred to, in which the carbonaceous material and the hydrocarbon are caused to pass through the retort heated on one side thereof and wherein the products of distillation pass toward the source of heat.

In the drawing I have shown a retort in which my process may be conducted continuously.

In the apparatus illustrated the retort is provided with a longitudinally movable floor 20, which is reciprocated by means of hydraulic cylinder and plunger 21, 22, or other suitable means. The carbonaceous material such as fine coal is mixed with from 3 to 15% of the hydrocarbons, such as petroleum, the exact amount depending upon the nature of the coal, and the combined mixture is placed in the hopper 23. When the conveyer floor 20 is moved inwardly, it carries the material resting thereon with it and permits additional material to fall from the hopper. Upon the outward movement of the floor 20 the material in the retort is prevented from moving outwardly with it by the wall or stripper 24. The reciprocation of the conveyer floor, therefore, causes a progressive movement of the material through the retort from the hopper 23 at the charging end to the discharge end. The outward movement of the floor 20 by forcing the material against the wall or stripper 24 and against the superimposed material in the hopper compacts the charge, and the material in the hopper and the charging end of the retort effectually seals

the retort at that end. The discharge end of the retort may be closed by a hood 25, opening to the atmosphere through a water seal and provided with a conveyer 26, or other suitable means may be employed for sealing the discharge end.

The retort is heated on one side only by series of fire flues 27 as described in my patent before referred to. Owing to the fact that the carbonaceous material is not instantly heated when it enters the retort, but can only be heated by causing the heat to be transmitted through a layer of the material, the layer situated adjacent to the heating surface is first heated and transmits its heat in turn to the next adjacent layer. This process of heating results in the gases passing into zones of increasing temperature, the highest temperature being adjacent to the heated surface and the lowest temperature being in that portion of the charge most remote from the heated surface. Owing to this method of transmission of the heat, gases are liberated from the carbonaceous material which is more remote from the heating surface at a temperature insufficient to decompose them and if these gases are not decomposed previous to being removed from the retort reactions do not take place. By causing the gases distilled from the materials at the lower temperature to pass through the material which is adjacent the heating surface and which is consequently at a higher temperature decomposition is readily brought about not only of the gases liberated from the hydrocarbons but also from the carbonaceous material, and the disassociated products are caused to react whereby the sulfur may unite with the carbon and form a liquid compound such as carbon disulfid, CS_2, the sulfur, carbon and nitrogen may unite to form sulfo-cyanid CNS, the hydrogen and nitrogen may unite to form ammonia NH_3, and various other combinations of sulfur, nitrogen, hydrogen, and carbon may be formed.

In the particular form of retort shown, the outlet pipe 19 from the oven for removing by-products is located in a position where the by-products will be drawn from the oven near the point of highest temperature, the products being caused to pass toward the source of heat. It will be apparent that the by-products may be drawn from the oven at other points if so desired.

In general, the principle distinguishing this process from those of the prior art is the simultaneous destructive distillation of oil and coal and causing the products of this distillation to pass immediately into zones of higher temperature in immediate contact with the products distilled at the higher temperature whereby further reactions are caused to take place—thus hydrocarbon compounds distilled at a low temperature immediately pass into zones of higher temperature and are surrounded by hydrocarbon compounds distilled at this higher temperature. The process in general, therefore, consists in distilling compounds at a low temperature and intimately mixing them with compounds distilled at a higher temperature and repeating this process until destructive distillation has been completed. The actions taking place are necessarily of the so called mass action in which a percentage of reverse action is possible, and hence there is not only a formation of new compounds, but also a restoration of the old compounds due to reactions in accordance with the well known principles of mass action in highly heated gases. It is, therefore, evident that this process differs materially in chemical action from processes in which the gases from coal or other carbonaceous material are first distilled and then mixed, or later united with gases from oil which has been distilled. The simultaneous distillation in zones of increasing temperature and the atomic contact with the complex hydrocarbon compounds produces reactions not obtained in the ordinary processes. Thus, ammonia NH_3, which is readily distilled from coal at a temperature of 400 to 700 degrees centigrade is almost entirely disassociated at a temperature of 1000 to 1200 degrees centigrade, causing hydrogen to be liberated and a large percentage of inert nitrogen. Part of the hydrogen so disassociated unites with part of the nitrogen, the remainder of the nitrogen escaping in the gas as inert nitrogen. By causing distillation to take place in the presence of carbon and of hydrogen which are in the atomic condition the nitrogen may be caused to combine with the hydrogen and the carbon, and does not, therefore, escape to the same extent as inert nitrogen. The ammonia and cyanid obtained by distillation in this manner are very markedly increased over distillation where the gases of hydrogen and of carbon being produced in the atomic condition are not available. The same tendency to form new compounds exists in connection with all volatile products, *i. e.*, hydrogen, carbon, sulfur, and nitrogen, and these are caused to form other complex compounds, accordingly increasing the yield of valuable by-products. At the same time impurities from the gases forming these combinations may be readily removed in subsequent treatment. In the treatment of illuminating gases, sulfur occurring in any other form than that of H_2S is subject to great difficulty in removing. The sulfur occurring as H_2S is readily removable by causing the hydrogen to unite with oxid of iron and causing the sulfur and iron to unite in the well known oxid of iron purifiers. The other products of sulfur are not remov-

able by the washers nor are the washers capable of removing the H_2S. In the passage of the gases through highly heated carbonaceous material as is done in this process other compounds of sulfur are readily handled in the condensing liquors. In practice the herein described process of distillation of hydrocarbon starts at a temperature of about 300 degrees centigrade, and the distillation will be carried to a temperature of 1000 degrees to 1200 degrees centigrade.

I claim:

1. The herein described process which consists in introducing into a closed retort a mixture of coal and hydrocarbon and then simultaneously distilling the mixture and passing the volatilized products toward the source of heat.

2. The herein described process which consists in mixing coal and oil, introducing the mixture into a closed retort, heating the mixture and causing the products distilled at the lower temperatures to pass to zones of higher temperatures in immediate contact with products distilled from the mixture at the higher temperatures.

3. The herein described process which consists in mixing hydrocarbons which are volatilized at a comparatively high temperature with hydrocarbons which are volatilized at a comparatively low temperature, introducing the mixture into a closed retort, heating the mixture, and causing the products of distillation to pass toward the source of heat.

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