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W. A. KÖNEMAN.

MANUFACTURE OF GAS.

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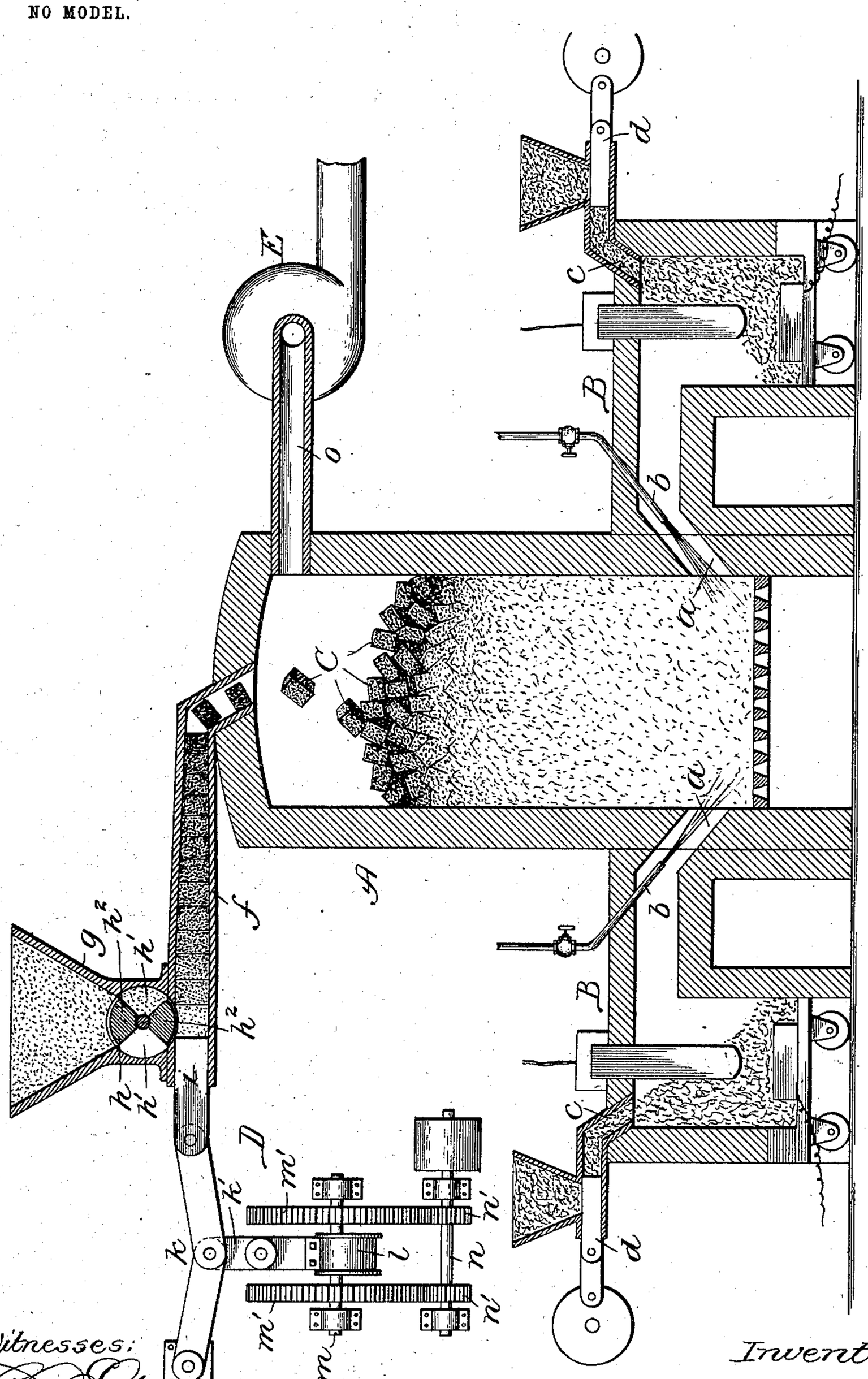
NO MODEL.



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No. 749,302. Patented January 12, 1904.

UNITED STATES PATENT OFFICE.

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MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 749,302, dated January 12, 1904.

Application filed May 18, 1903. Serial No. 157,610. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KÖNEMAN, 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 the Manufacture of Gas, of which the following is a specification.

My invention relates to an improvement in the manufacture of water-gas on the principle set forth in Letters Patent of the United States No. 546,702, granted to me September 24, 1895, involving continuity of the gas-generating operation by employing the heat of the electric arc to compensate for maintaining the incandescent condition of the fuel against the heat-absorbing effect of the steam employed in undergoing decomposition.

The primary object of my invention is to bring about improved economic conditions in the manufacture of water-gas while employing the aforesaid principle.

To accomplish my object, I take advantage of the fact that in the various uses of the electrometallurgical furnace a large proportion of the heat from the electric arc is wasted. Thus, for example, in the use of the electric furnace for the manufacture of calcium carbid by far the larger portion of the heat from the arc is lost, as will be apparent from the calculations hereinafter presented, and my purpose is to utilize the surplus heat made thus available, which amounts to fully seventy-five per cent. of the total heat, the portion taken up by the work in the furnace and through loss by radiation being less than twenty-five per cent. of the total.

While to practice my improved process a suitable electric furnace employed for other work is required, my invention is not limited to the use of such a furnace employed for any particular purpose. For the sake of illustration, however, and because of preference I confine the explanation hereinafter contained mainly to the operation of the electric furnace in the manufacture of calcium carbid in combination with a gas-producer, and since the best results are attainable in the manufacture of gas according to my improved process by providing the carbonaceous material in the form of briquets of the kind forming the subject of my United States Letters Patent No. 711,167, dated October 14, 1902, I show in the accompanying drawing as part of the apparatus suitable for the practice of my improvement a briquet forming and feeding machine connected with the gas-producer.

The accompanying drawing shows by a view in vertical sectional elevation for the manufacture of water-gas according to my improved process a gas-producer with a plurality of electric furnaces connected with it at different points near its base for discharging therein their surplus heat, steam-jets discharging into the producer near its base, and a briquet-machine for feeding into the producer at its upper end the fuel in the form of briquets.

A is a gas-producer of any desired construction.

B B denote electric furnaces of any suitable type.

My calculations are based on the employment of the electric furnace as used for the production of calcium carbid, and in order to show the full benefits which may be derived therefrom I assume that the gas is manufactured from my aforesaid patented anthracite and bituminous briqueted fuel and that ten tons of this fuel are to be converted into gas in twenty-four hours, which would be the capacity of two generators, each requiring to be connected with four carbid-furnaces, each receiving a current of two hundred and fifty electric horse-power generated by water-power. Owing to the nature of the view selected for the illustration, only two of the furnaces B are shown to be connected with the producer through conduits *a a*, leading into it at opposite sides near its base, with steam-jets *b* directed into the producer through the conduits from a suitable source of steam-supply. (Not shown.) Moreover, the supply of materials to each furnace to be subjected therein to the action of the arc for converting it into calcium carbid is shown to be through a feed-passage *c*, discharging into the top of the furnace under pressure from a reciprocating piston *d*, driven by suitable power (not shown) for closing the passage to the access of air for a purpose hereinafter described.

The fuel C in the preferred form of briqueted finely-pulverized anthracite and bituminous coal agglutinated together and in the proportions specified in my aforesaid Patent No. 711,167 is fed to the producer A by a suitable apparatus, such as that shown at D, and involving the following-described construction: A tube *f* of proper cross-sectional dimensions to form a briquet of desired thickness and open at both ends is supported to discharge at one end into the producer through its top. On the tube near its outer end is seated a hopper *g*, provided in its open base with a rotating cylinder *h*, containing opposite pockets *h'* between said segments h^2, the capacity of each pocket being for sufficient material to form a briquet. The pulverized mixture of coals supplied to the hopper fills each pocket *h* as it comes by the rotation of the cylinder into position to receive the supply and is dumped by the continued rotation of the cylinder into the tube *f* in advance of a piston *i* while the latter is on its back stroke. The piston *i* is shown connected with a toggle device *k*, having a link connection *k'* with a cam *l* on a rotary shaft *m*, carrying gear-wheels *m'*, meshing with pinions *n'* on a suitable drive-shaft *n*. The action of the cam *l* against the toggle device reciprocates the piston *i* to compress the material fed in suitable quantity from a pocket *h* in advance of it into the tube *f* into a briquet C, the mechanism being so timed that a pocket dumps its contents during the back stroke of the piston and is in position to be filled from the hopper during the forward piston-stroke. Thus by the briquet-forming action of the piston *i* the briquets are also fed into the producer and in their desirable green condition by the crowding of the briquets through the tube *f*. The piston *i*, moreover, closes the tube against the ingress of air in the same way that the piston *d* closes the passage *c*. It is very important that no air be admitted either into the electric furnaces during their operation or into the gas-producer while it is being charged with fuel, as it would produce the presence of nitrogen gas, and the pistons referred to prevent the admission of objectionable air.

At E is shown a suction-fan in a conduit *o*, leading from the upper end of the gas-producer, for taking off to a suitable holder (not shown) or to the point of its consumption the gas generated in the producer from the fuel therein under the action of the steam admitted to it and the surplus heat from the furnaces supplied continuously to it both for generating gas from the fuel and for supplying to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

The following calculation demonstrates the economic advantage afforded by my improvement: One electric horse-power produces in practice eight and one-tenth pounds of calcium carbid in twenty-four hours. One electric horse-power being equal to 2,182.54 heat units, it follows that the heat used to produce eight and one-tenth pounds of calcium carbid is fifty-two thousand three hundred and sixty-eight heat units. The eight and one-tenth pounds of carbid produce forty-one cubic feet or 2.56 pounds of acetylene gas containing seventeen thousand seven hundred heat units per pound. Hence 2.56 pounds of acetylene gas, representing eight and one-tenth pounds of carbid, give off on combustion forty-four thousand two hundred and eleven heat units.

The heat produced by one electric horse-power in twenty-four hours equals fifty-two thousand three hundred and sixty-eight heat units. The heat contained in the carbid product in twenty-four hours equals forty-five thousand three hundred and twelve heat units; but to produce the eight and one-tenth pounds carbid there has been consumed, on the basis of its composition of ten parts CaO to seven parts C, a quantity of carbon representing forty-one and eighteen one-hundredths per cent. or three and one-third pounds, which is incorporated in the calcium carbid. The heat contained in this carbon is forty-six thousand six hundred and sixty-six heat units or practically the amount which the resultant acetylene from eight and one-tenth pounds carbid gives off on combustion, showing that nearly all the heat from the electric arc is unused and serviceable for extraneous utilization.

As the basis for my calculations I cite the heat reactions on two thousand pounds of pure carbon. Two thousand pounds carbon burned to CO generate two thousand multiplied by four thousand four hundred heat units equals eight million eight hundred thousand heat units. Two thousand pounds combine with two thousand six hundred and sixty-six pounds oxygen and form four thousand six hundred and sixty-six pounds CO. Two thousand six hundred and sixty-six pounds oxygen obtained from steam are combined with 296.22 pounds hydrogen. 296.22 pounds hydrogen absorb in dissociation eighteen million three hundred and sixty-five thousand six hundred and forty heat units. Credit the heat generated by carbon burned to CO eight million eight hundred thousand heat units and we have heat absorbed in excess of heat generation nine million five hundred and sixty-five thousand six hundred and forty heat units. This gives us two thousand pounds carbon to CO, equaling four thousand six hundred and sixty-six pounds, CO equaling sixty-two thousand nine hundred and ninety-one cubic feet. 296.22 pounds hydrogen equals fifty-six thousand two hundred and eighty-one cubic feet, and as the total from one ton of carbon, one hundred and nineteen thousand two hundred and seventy-two cubic feet.

When produced by the electrical furnace, each one thousand feet of gas requires eighty

thousand two hundred heat units to make up shortages, and this shortage is to be supplied by electric means. As one electric horse-power gives two thousand one hundred and eighty-two heat units per hour, it follows that the heat required by each one thousand feet of gas amounts practically to thirty-seven electric-horse-power hours. All minor factors are omitted from these calculations to avoid confusion; but I shall estimate on forty electric-horse-power hours as being required for each one thousand cubic feet.

The conversion of ten tons of the briqueted fuel into gas by means of surplus heat from the electrical calcium-carbid furnace will give the following results in carbid and in gas, the manufacture being a duplex operation: Ten tons of briquets have a composition of about eighty-seven per cent. of combustible matter and thirteen per cent. of ash and give seven and one-half tons of carbon and 1.2 tons of volatile hydrocarbons. One ton of carbon, as has already been shown, gives one hundred and nineteen thousand two hundred and seventy-two cubic feet, and the seven and one-half tons therefore give eight hundred and ninety-four thousand five hundred and forty cubic feet. 1.2 tons of hydrocarbons give forty-eight thousand cubic feet; total, nine hundred and forty-two thousand five hundred and forty cubic feet. The electrical power required to produce this amount is 942.5 multiplied by forty electric-horse-power hours, equaling thirty-seven thousand seven hundred electric-horse-power hours or one thousand five hundred and seventy electric horse-power. If this is to be supplied by waste heat from carbid-furnaces, it only represents seventy-five per cent. of the heat which must be actually employed in the furnaces, and the amount of current initially used is therefore two thousand and ninety-three electric horse-power, and the amount of current to be provided in this waste heat amounts to fifty-three electric-horse-power hours per one thousand feet of gas made. The two thousand and ninety-three electric horse-power employed will produce sixteen thousand nine hundred and fifty-three pounds calcium carbid in twenty-four hours, or allowing for waste of sixteen thousand pounds, which at seventy dollars per ton has a gross value of five hundred and sixty dollars, and allowing forty dollars per ton as the cost we obtain net results of two hundred and forty dollars per day from the carbid produced, leaving the waste heat from the carbid-furnaces free of cost. The waste heat so provided is sufficient to counterbalance the heat abstracted by the dissociation of steam, which for seven and one-half hours centigrade amounts to nine million five hundred and sixty-five thousand six hundred and forty heat units per ton or a total of seventy-two million seven hundred and forty-two thousand three hundred heat units, whereas seventy-five per cent. of two thousand and ninety-three electric horse-power amounts to two thousand one hundred and eighty-two heat units per electric-horse-power hour, mutiplied by twenty-four hours times two thousand and ninety-three times seventy-five or eighty-two million two hundred and four thousand five hundred and sixty-eight heat units, thus leaving nine million four hundred and sixty-two thousand two hundred and sixty-eight heat units for the distillation of the 1.2 tons of hydrocarbons, the final result being that only labor and fuel are chargeable against the gas, all proper expenses having been charged against the carbid-furnaces. We thus have as carbid profits two hundred and forty dollars; fuel, (in the Eastern States at two dollars per ton,) twenty dollars; labor of twenty-four men at two dollars per day, forty-eight dollars, leaving nine hundred and forty-two thousand five hundred and forty cubic feet of gas free of cost and producing a profit of one hundred and seventy-two dollars per day, besides on each ten tons of fuel gasified, from which must be deducted the cost of purifying and delivering gas to holders, interest on investment and amortization.

What I claim as new, and desire to secure by Letters Patent, is—

1. The method of economically manufacturing gas, which consists in introducing steam into a producer containing a bed of carbonaceous material, and conducting into said producer, from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from said carbonaceous material and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

2. The method of economically manufacturing gas, which consists in introducing steam into a bed of briqueted carbonaceous fuel in a gas-producer, and conducting into said producer, from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from such fuel and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

3. The method of economically manufacturing gas, which consists in introducing steam into a bed of fuel-briquets composed of an agglutinated mixture of anthracite and bituminous coals in suitable proportions and contained in a producer, and conducting into said producer, from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from said fuel and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

4. The method of economically manufac-

turing gas, which consists in feeding carbonaceous fuel to a gas-producer and meantime excluding therefrom air, introducing steam into said producer and conducting into the same from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from said fuel and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

5. The method of economically manufacturing gas, which consists in feeding to a producer, and meantime excluding air therefrom, fuel-briquets composed of an agglutinated mixture of anthracite and bituminous coals in suitable proportions, introducing therein steam, and conducting into said producer, from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from said fuel and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

6. The method of economically manufacturing gas, which consists in forming and simultaneously feeding to a gas-producer coal-briquets in a green condition and excluding the admission of air while feeding, introducing steam into said producer, and conducting into the producer, from an operating electric furnace surplus heat, practically free from nitrogen, from the arc therein to generate gas from said briquets and supply to the producer an amount of heat greater than the amount thereof abstracted by dissociation of the water-vapor.

WILLIAM A. KÖNEMAN.

In presence of—

WALTER N. WINBERG,

W. B. DAVIES.