(No Model.) 2 Sheets—Sheet 1.

L. MOND.

APPARATUS FOR PRODUCING GAS,

No. 546,049. Patented Sept. 10, 1895.

Fig. 2.

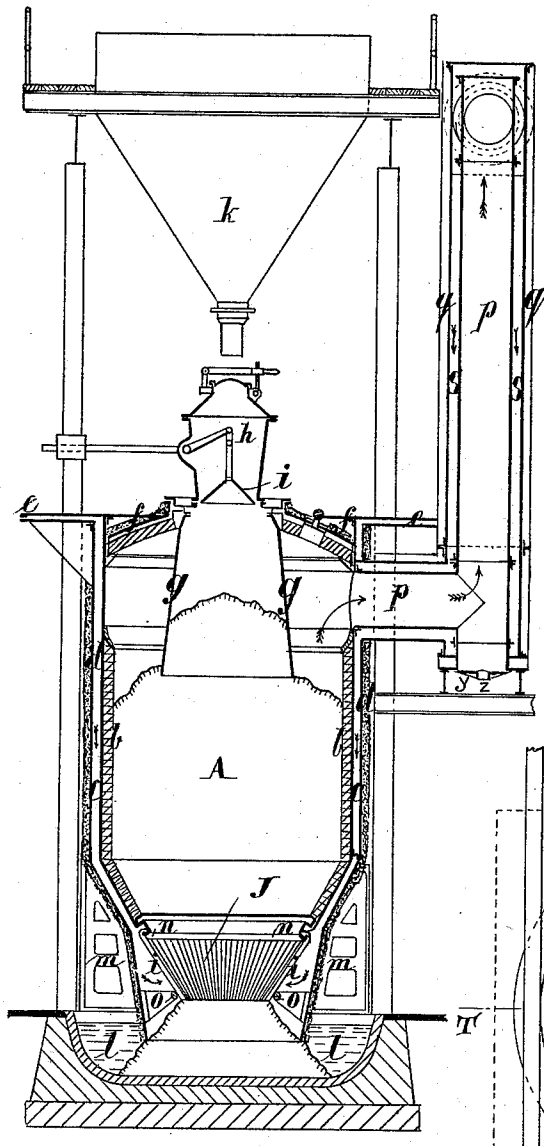
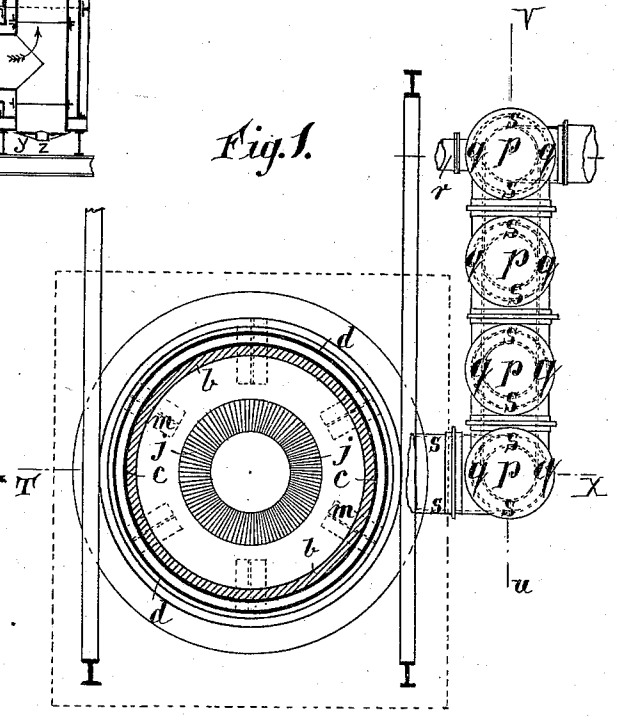


Fig. 1.



Witnesses
M. R. Kennedy
F. L. Elmore.

Inventor
Ludwig Mond
By his Atty
Philip T. Dodge

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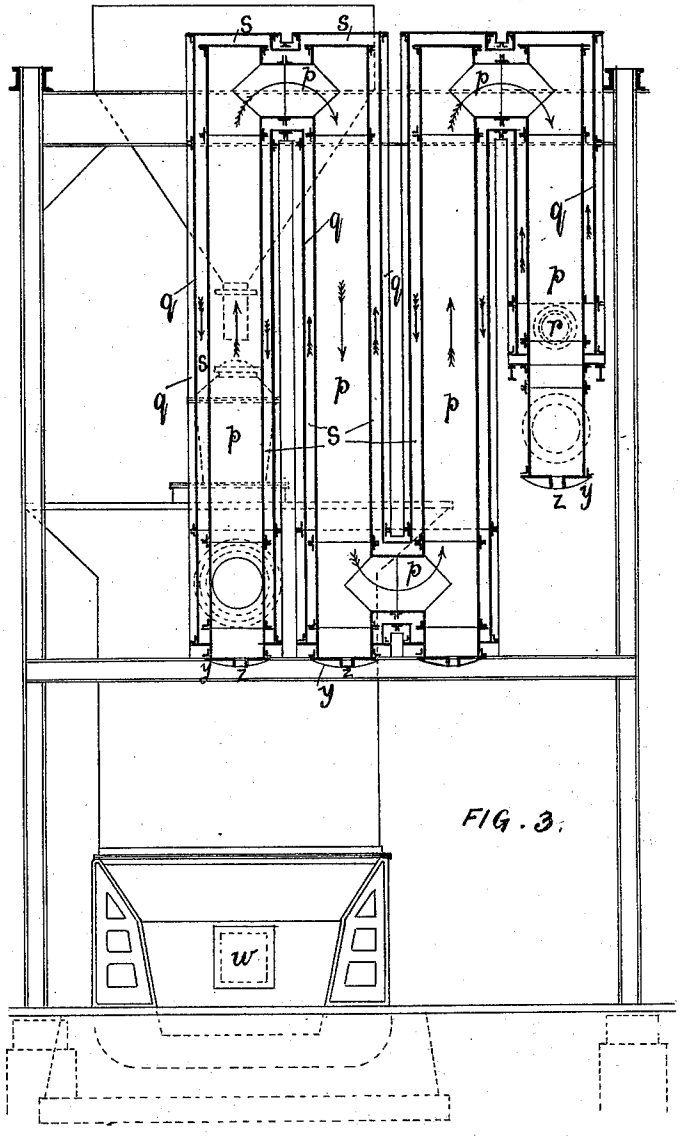

FIG. 3.

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UNITED STATES PATENT OFFICE.

LUDWIG MOND, OF LONDON, ENGLAND.

APPARATUS FOR PRODUCING GAS.

SPECIFICATION forming part of Letters Patent No. 546,049, dated September 10, 1895.

Application filed August 23, 1894. Serial No. 521,110. (No model.) Patented in England June 22, 1893, No. 12,440.

To all whom it may concern:

Be it known that I, LUDWIG MOND, a subject of the Queen of England, residing at London, England, have invented certain new and useful Apparatus for Producing Combustible Gases, Ammonia, and Tar from Fuel, (which has not been patented to myself or others except in England, No. 12,440, dated June 22, 1893,) of which the following is a specification.

This invention is for apparatus for producing combustible gases, ammonia, and tar from fuel, and has for its object the obtaining as a by-product in the manufacture of producer gas of a larger percentage of ammonia from the fuel than has hitherto been achieved and at the same time to cheapen the production of the producer gas. It has already been proposed to use a mixture of superheated steam and cold air for obtaining ammonia from fuel burned in gas-producers, but this becomes impracticable if the mixture of air and steam is to be obtained economically—as, for instance, by the method I have described in my English Patent No. 8,973 of 1885—while if the steam required has all to be raised in steam-boilers and to be superheated sufficiently to attain the object of this present invention a greater expenditure would have to be incurred for extra fuel than would be compensated for by the increase in the ammonia obtained. Circular gas-producers with an annular space round them for the purpose of heating the air entering the producer have been described long ago, and also several devices have been described for heating this air by means of the waste heat of the gas-producers; but none of these are sufficient to attain the rise of temperature required for my purpose. I have found that by burning fuel with a mixture of air and steam in proper proportions raised to a temperature of not less than 150° centigrade, the quantity of ammonia obtained from the fuel is largely increased, and a valuable tar is also obtained, and I have designed an apparatus by which such a mixture of air and steam can be economically raised to this temperature by the waste heat of the gas-producer without the expenditure of extra fuel. In order to effect this purpose, I surround the combustion-chamber in which the fuel is burned with a box or mantle, thus forming a hollow space around it. I also take the hot gases made in the combustion-chamber through long pipes, preferably arranged in zigzag, which I surround by larger pipes, thus forming an annular space or spaces, and I pass the mixture of air and steam on its way to the combustion-chamber through this annular space or spaces in a direction contrary to the current of hot gases, and subsequently I pass it through the hollow space formed round the combustion-chamber, and take it from thence into the bottom of the combustion-chamber. The gases leaving the combustion-chamber are cooled in their passage through the long pipes, but they still retain heat enough to serve for the purpose of the production of such mixture of air and steam, as set forth in my before-mentioned English Patent numbered 8,973 and date of 1885. I prefer to make the gas-producer of circular section and to construct it of a wrought-iron casing lined inside, up to a certain height, with a thin lining of fire-bricks, and of a second wrought-iron casing surrounding the first one, the outside of which is covered by a non-conducting material. An annular space is thus formed between the two wrought-iron casings all around the combustion-chamber, through which the mixture of air and steam passes downward on its way to the grate at the bottom of the combustion-chamber and becomes heated to the desired temperature. I insert a cast-iron cylinder or a truncated cone into the top of this combustion-chamber, which reaches some distance down inside the inner casing, and into which I charge the fresh fuel from time to time, and I keep this cylinder or truncated cone at all times partially filled with coal, whereby I avoid coal-dust getting into the long gas-pipe, and also gasify the volatile products of the fuel more perfectly.

My invention is best described by the aid of the annexed drawings.

Figure 1 is a ground plan of conduit and horizontal section through center of chamber A; Fig. 2, a vertical section through the line T X, Fig. 1; Fig. 3, a vertical section through the line U V, Fig. 1, showing, also, the front view of the gas-producer.

Like letters relate to like parts in all these figures.

A is the body or combustion-chamber of the gas-producer, surrounded by *b b*, brick lining; *c c*, inner iron casing; *d d*, outer iron casing.

e e is a hollow iron platform to which both these casings are riveted and which allows unequal expansion of the two casings to take place without damaging the structure.

f f is the top of the gas-producer, consisting of a single iron cover fastened and made tight to the inside shell and lined with brickwork.

g g is a bell-shaped casting, which is always kept partly filled with fuel and which is charged by means of a feed-hopper *h*, into which the fuel is delivered from the reservoir *k*.

j is a conical grate, *l l* is a water-lute, and *m m* the feet carrying the whole structure.

p p p are the pipes or conduits for the producer gas, surrounded by pipes *q q* of larger diameter, thus forming an annular space *s s* through which the mixture of air and steam, is forced into the apparatus by a suitable fan or blower entering through the pipe *r*, Fig. 3, and passing round the pipes *p p p* and subsequently through the annular space between the two iron shells *c* and *d*, Fig. 1, in the direction of the arrows, until it arrives at the grate *j*, taking up heat all the way, and thus arriving at the desired temperature. The gas issuing from the producer carries with it some dust, which is apt to settle in the pipes *p p p*, and requires removing from time to time. These pipes *p p p* are therefore arranged vertically in zigzag form, with short horizontal branches between them, and are provided with blank flanges *y y* at their bottom to make them accessible for cleaning and with a small opening *z z* (closed by a plug or cock) in these flanges through which the dust can from time to time be blown out without interfering with the work of the producer. To avoid loss of heat the pipes *q q*, as well as the outer shell *d d* of the producer, are covered with a non-conducting composition. The inner shell of the producer ends in the casting *n*, which carries the wedge-shaped fire-bars *i i i* of the conical grate *j*, which are supported by a ring *o o*.

This apparatus is especially well adapted for burning very poor qualities of fine fuel, even those of coking character. The clinkers have no tendency to stick to the sides of the producer, and even a coking fuel descends very regularly and easily, requiring no assistance by poking with bars from the top. The conical grate provides a very regular admission of the mixture of air and steam through all the sections of the fuel in the producer, thus avoiding partial overheating and the consequent destruction of ammonia, which it is the object of the invention to obtain in the greatest quantity in the gas, to be separated by a subsequent operation in any well-known manner. The removal of the clinkers which fall through the opening in the center of the grate into the water-lute is easily effected without in any way interrupting the continuous work of the producer, although the mixture of air and steam is generally forced into the producer under a pressure of six to nine inches of water in order to overcome the resistance of the fine fuel, and to burn a quantity of fuel in the apparatus adequate to its size and cost.

The interstices between the bars of the grate are subject to be blocked from time to time by agglutinated fine dust, which is easily removed by knocking about the bars which are made movable for this purpose, and which are readily accessible through doors *w*, Fig. 3, provided in the lower part of the outer shell a short distance above where it dips into the water-lute. The proportion of steam and air varies with the temperature, and also to some extent with the composition of the fuel and should be as much as can be safely applied without extinguishing the fire, under which circumstances the fire has only a dull-red appearance.

I declare that what I claim is—

1. In an apparatus for producing combustible gases, ammonia and other by-products from fuel, the combination of substantially the following three parts or combinations: (A) a circular gas producer combustion chamber having a cylindrical iron shell, a dome-shaped top, a truncated conical bottom, a thin brick lining in the part exposed to the combustion, a metallic ring carrying the above, a grate of the shape of a truncated cone having the apex downward and constructed of wedge-shaped movable bars, two rings supporting said bars in such position as to give the bars a slope of about forty degrees, said bars ending a considerable distance from the vertical center line, leaving a sufficient opening in the center for the clinker to pass through and approximately parallel spaces between the bars for the air and steam to pass, a feed hopper above the combustion chamber and a cast iron cone reaching from below the hopper to a certain depth into the combustion chamber, whereby the fuel can gradually descend from the same into the combustion chamber; (B) an outside metallic shell (forming an annular chamber round the combustion chamber) drawn together at its lower part to a truncated cone nearly parallel to the conical part of the inside shell, and at a steeper angle round the conical grate, a water-lute below into which it extends, said shell having an expansion joint connecting it air tight at its top with the shell of the combustion chamber, whereby unequal expansion is allowed for, said expansion joint forming a platform round the top of the combustion chamber; (C) a series of iron exit pipes for the hot gases arranged vertically in zigzag (for conveying the gases to where they are separated or utilized) connected at one end with the combustion chamber and having a series of wider pipes surrounding them forming an annular space, said outside pipes being connected to the chamber surrounding the combustion cham-

ber at one end and at the other to the air and steam supply, so that the air and steam for maintaining combustion can be passed through the outer pipes in the reverse direction to the course of the hot gases in the inner pipes and subsequently through the annular space around the combustion chamber to the space around the conical grate, and thus the air and steam become heated to the required temperature and the escaping gases cooled.

2. The combination of an inner cylindrical shell forming a combustion chamber, having an inverted truncated conical lower part, an inverted truncated conical grate below, an outer shell inclosing said chamber and grate, and forming a nearly uniform concentric space surrounding them, but said outer shell extending below the grate at bottom, a water-lute into which the outer shell dips, supports for both shells, above this lute, and an expansion joint connecting the two shells at top in an air-tight manner forming a platform.

3. The combination of the combustion chamber A, having exit pipes *p* and conical grate J, legs *m*, water-lute *l* and a heating chamber *s* surrounding the pipes *p* and the chamber A and grate J and having entrance for air and steam at its farther end, and its end nearest the grate bars dipping down below the grate bars into the water-lute, whereby the heat radiating from the chamber *s* and that of the effluent gases are given up to the feed air and steam, and the latter can enter the combustion chamber nearly all round and the clinker and ashes can be removed through the water seal.

In testimony whereof I have hereto set my hand in the presence of the two subscribing witnesses.

LUDWIG MOND.

Witnesses:
ALFRED J. BOULT,
HARRY B. BRIDGE.