(No Model.) 3 Sheets—Sheet 1.

J. L. STEWART.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 454,409. Patented June 16, 1891.

Fig. 4.

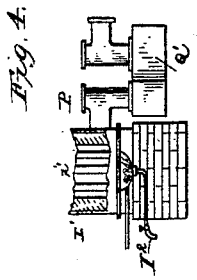

Fig. 1.

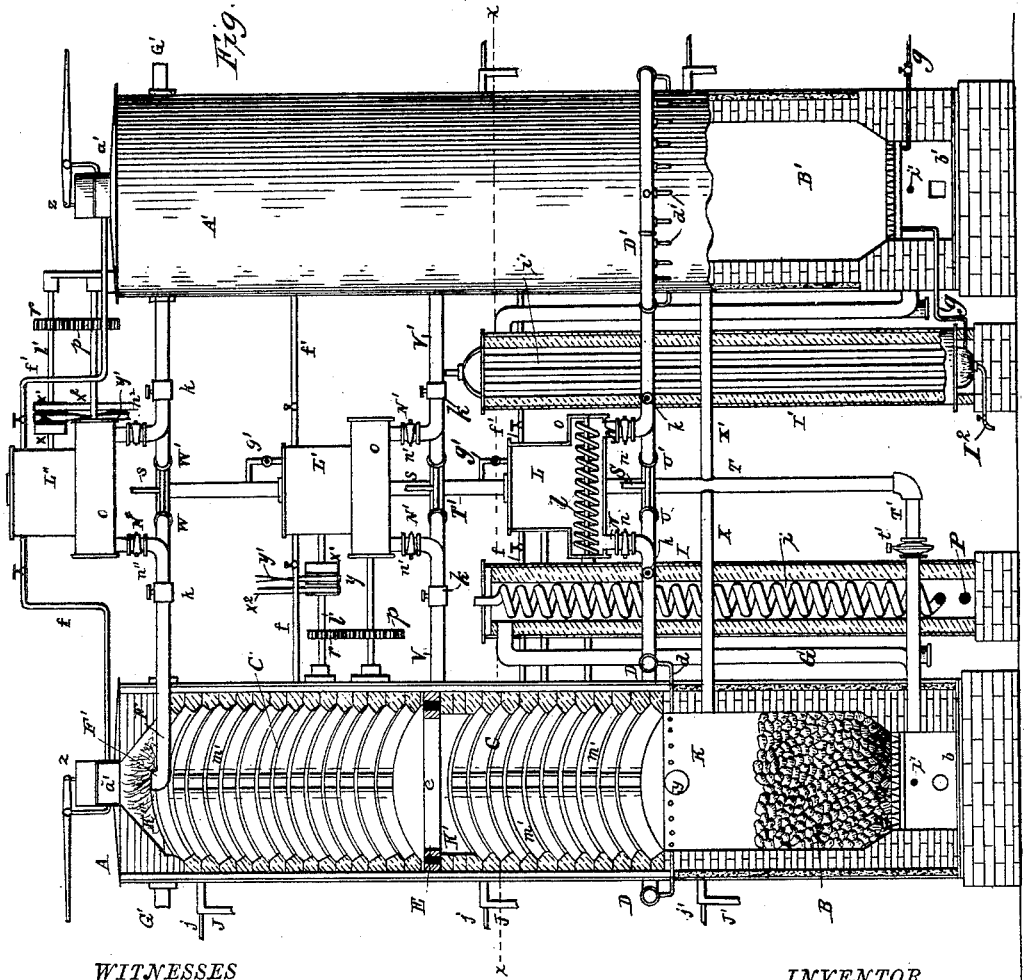

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Fig. 2.

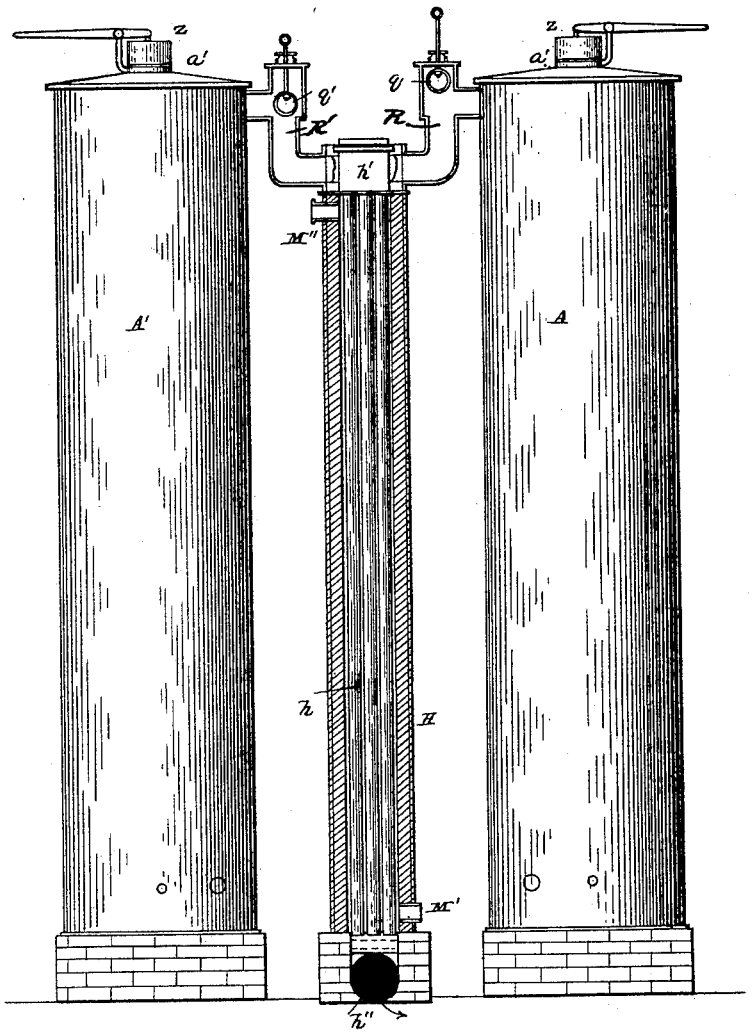

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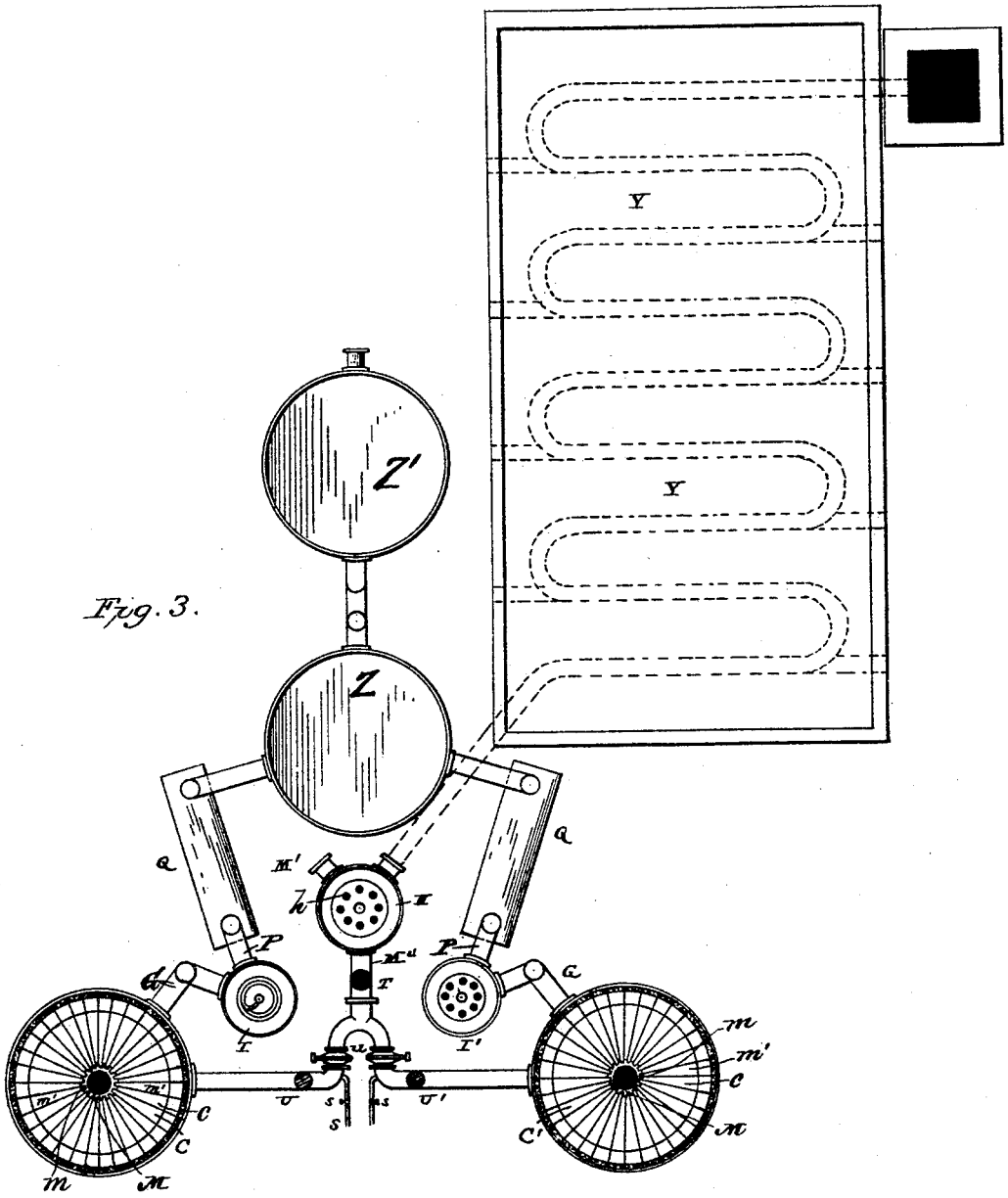
Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN L. STEWART, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 454,409, dated June 16, 1891.

Application filed August 22, 1887. Serial No. 247,605. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. STEWART, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for the Manufacture of Gas; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the manufacture of illuminating and heating gas by utilizing low-priced carbonaceous fuel in the form of dust or slack and cheap hydrocarbons—such as crude petroleum—in a cupola-generator provided with numerous brick-work flues.

This invention embraces certain improvements on the apparatus described in my application bearing Serial No. 227,537, filed February 14, 1887; and my object is more particularly to provide a convenient arrangement of devices for feeding carbon-dust to two generating-furnaces; to provide for heating air and superheating steam by escaping hot products of combustion and hot gas, to provide for heating the generators and decomposing steam with cheap crude hydrocarbon oil, as well as with coal-dust, and to provide for generating gas continuously and send a constant flow thereof to a metallurgic or glass furnace, or other place of consumption.

The matter constituting my invention will be defined in the claims.

In the accompanying drawings, Figure 1 represents an elevation of a pair of cupola generating-furnaces and connecting steam-superheaters and fuel-feeders, partly in vertical section. Fig. 2 represents an elevation of the generators and a vertical section of the tubular air-heater, the steam-superheaters being omitted. Fig. 3 represents a horizontal section on line $x\,x$, Fig. 1, with the coal-dust feeder removed. Fig. 4 is an elevation of the seal-box and lower portion of the superheater.

The cupola-furnaces A A′ are built up of brick with linings of fire-brick resting upon masonary foundations, and they are covered with tight jackets of riveted boiler-iron.

The description of one cupola-furnace will suffice for both. The usual fuel-chamber B, grate and ash-pit b are provided at the base of the cupola, and doors are provided in the wall above and below the grate. The grate is preferably made hollow and provided with a steam or water inlet pipe g, so that steam or water may pass through it on the way to the superheater I or I′, thereby cooling the grate and heating the steam or water. A steam-supply pipe i' opens into the ash-pit. The decomposing and converting chambers C C′ are composed of successive brick arches closely superposed one above another, and formed of large triangular brick or tile m', extending from the circumferential wall to the central hollow key-brick M. The tile are preferably made solid and set a sufficient distance apart to form narrow radial openings c between them. They rest at their outer ends upon the beveled brick of the wall, and at their inner ends in vertical grooves m in the central hollow key-bricks M, whereby they are securely held in place. The key-bricks being hollow, they form a central vertical flue. The tiles m' are set in vertical lines, one above another, in the successive arches, so as to form numerous vertical flues through the decomposing and converting chambers. A combustion-chamber K is provided above the fuel-chamber, and similar combustion-chambers K′ K″ are provided above chambers C′ C″ for receiving the coal-dust, air, oil, and steam. The cupola is provided at top with a large neck or passage a', closed by a lid z. A fuel and firing opening y, having a closing-lid, is provided in the wall of chamber K, and a similar opening and lid may be provided in the wall of chamber K′. The annular air-blast and dust-feeding pipe D connects by numerous short branch pipes d with combustion-chamber K, and pipe D has connecting with it the air-blast pipe U, having valve u, Fig. 3, leading from main blast-pipe T. Pipe N, having valve n, connects the carbon-dust box L with pipe U. A second pipe N, having valve n, connects the opposite end of dust-box L with blast-pipe U′, leading to annular pipe D′, having numerous pipes d' opening into the combustion-chamber of cupola A′. In the wall of

combustion-chamber K′ the annular blast and dust-feeding flue E is formed and provided with slots or narrow ports *e*, leading through the wall into combustion-chamber K′. Blast-pipes V V′ lead from blast-pipe T′ and connect with the annular flues E in both furnaces, and dust-pipes N′, having valve *n′*, lead from opposite ends of dust-box L′ and connect with pipes V V′. Blast-pipes W W′ lead from blast-pipe T and extend into pipe F, leading into chamber K″ at the tops of the cupolas, and dust-pipes N″, having valves *n″*, lead from opposite ends of dust-box L″ and connect with pipes F and W W′. Valves *k k* are applied to pipes W W′ to shut off the supply of air, which is not usually required at the top of the furnace. Steam-supply pipes S connect with pipes U U′, V V′, and W W′ just back of the connections of dust-supply pipes N″ for injecting the dust when it its required to make gas. In the furnaces the ends of the horizontal pipes F are turned up to form nozzles F′, whereby the dust is better distributed and showered by the steam or air. The pipes for delivering dust, air, and steam are provided with valves *k* near the generator, so as to shut off connection with one generator while dust and air are being supplied to the other, when desired. The feed-boxes L L′ L″ are provided at their bottoms with troughs *o*, in each of which is journaled a screw conveyer *l*, composed of comparatively narrow blades spirally twisted around the shaft and connected thereto by radial spokes. This form of conveyer keeps the carbon-dust stirred up and prevents packing and clogging. The projecting end of the shaft of the conveyer is provided with a large gear-wheel *p*. A shaft *l′* is journaled a short distance above trough *o*, and carries a pinion *r*, which meshes into gear-wheel *p*. It also carries the two outer loose pulleys *x x′* and the middle tight or fixed pulley *y*. A straight belt x^2 and a crossed belt *y′* are arranged upon the pulleys and upon pulleys of a driving-shaft, and belt-shifters are provided, so that by placing the straight belt on the tight pulley the spiral conveyer will be turned in one direction and feed into one generator, and by shifting the straight belt and placing the crossed belt on the tight pulley the conveyer will be turned in the other direction and feed into the other generator. The two generators can thus be conveniently fed at one level from one box with one set of gearing. The gear-wheels and pulleys are arranged alternately upon opposite sides of the boxes for more conveniently making connection with the main driving-shaft. Small gas-pipes *f f′*, provided with valves lead from the generators to the top of the dust-boxes, so as to equalize the pressure in the generator and boxes, whereby the dust will fall by its own gravity into the blast or distributing feed-pipes when making gas. Pipes and valves *g′* lead from the air-blast pipes to the dust-boxes to equalize the pressure when heating up the cupolas by the combustion of dust with air. The dust-boxes are made gas-tight and have tight-closing lids. Oil-supply pipes J, having connecting steam-pipe *j*, open into the chambers K K′ K″ of the cupola to supply oil either for burning, and thereby heating the brick flues in chambers C C′, or for decomposition with steam in making water-gas. Separate air-blast pipes X X′, as shown, connecting with chambers K, may connect with all the combustion-chambers to insure a sufficient supply of air to burn both the carbon-dust and the oil. The gas-take-off pipe G leads from the base of the cupola, either just above the grate or below it, as shown, and exteuds to the top of the superheater I, and a pipe P leads from the bottom of the superheater into seal-box Q. The superheating-chambers I and I′ are preferably built of brick, covered with tight iron jackets. The steam-conducting pipe is either made in the form of a coil *i*, as in chamber I, or in the form of a series of straight pipes *i′*, as in chamber I′. The straight pipes open into boxes at both ends of the superheater. In both cases the outgoing hot gas circulates around the steam-conducting pipe. A blow-off pipe and valve I^2 connect with the bottom of chamber I′ for discharging water of condensation. The tubular air-heater H is provided with vertical tubes *h*, connecting at top with box *h′* and at bottom with box *h″*. Pipes R R′, having valves *q q′*, connect the tops of the cupolas with box *h′* and conduct thereto hot products of combustion. The waste partially-cooled products, after having passed down through tubes *h*, pass from box *h″* into the flues of coal-drying floor Y. The cold-air-inlet pipe M′ connects with the bottom of heater H, and outlet-pipe M″ for hot air connects with the top thereof and with the vertical pipe T, from which various branch pipes lead to the combustion-chambers of the cupolas. Gas-take-off pipes G′ may lead from the tops of the cupolas to the steam-superheating chambers. Wet and dry scrubbers Z Z′ are connected with pipes leading from the seal and wash boxes for cooling and purifying the gas. The flues of the coal-drying floor have ports or openings at the ends, so that they may be cleaned. The coal-dust is preferably dried on the floor Y before being supplied to the feeding-boxes, as it may then be uniformly fed without clogging.

In operating the generators lids *z* are opened, a fire is first kindled in each chamber B B′ and fed with coal till a body of ignited fuel is formed in each chamber. The fire is urged by an air-blast and the resulting gaseous products are burned by air-blasts admitted to chambers K and K′, thereby heating the brick-work in chambers C C′. After the bed of fuel is well ignited carbon-dust may be blown in with the air-blasts and

burned in chambers K K′. At the subsequent periods of heating up chambers C C′, I use carbon-dust or cheap crude oil for such purpose, as the operation can be performed more economically with such fuel than with the hard lump-coal used in the fuel-chamber B. The oil for combustion is blown in by steam-jet or by steam and air and care is taken to admit sufficient air to secure complete combustion. The oil may be first vaporized in a still and the vapor supplied to the cupola either for heating up or for decomposition to make water-gas. When bituminous-coal dust is blown by an air-blast through pipes D *d*, a long flame is produced and gaseous products are given off which require a second supply of air in chamber K′ to produce complete combustion. Under such circumstances, therefore, little or no dust should be supplied with the blast through flue E. If anthracite dust only is used, it should be supplied to and burned in both chambers K K′. The decomposing-chambers C C′ being properly heated to a high degree of heat, the air-blasts and the dust-supplies from boxes L L′ are shut off. Then carbon-dust is admitted from box L″ through pipe N″ and valve *n*″ into horizontal pipe F and discharged by a steam-jet through the upturned nozzle F′, from which it is distributed in a shower over the tops of the vertical flues in chamber C′. The mixture of dust and steam passes down into the highly-heated flues *c*, where the steam is decomposed with the formation of carbonic oxide and hydrogen. Hydrocarbon oil may be sprayed in with steam instead of dust, or both the oil and dust may be used for causing decomposition of the steam. When the heat is high and decomposition active, steam and dust and oil may be admitted into chamber K′ as well as chamber K. The gases pass down through the bed of incandescent fuel, where any carbonic acid present is converted into carbonic oxide, and any vapor is converted into fixed gas. The hot gas passes off through the superheating-chamber and superheats the steam passing through the coil or series of pipes. The superheated steam passes to the supply-pipes of the cupola for blowing the dust and oil. While water-gas is being made in one cupola the other one is preferably heated up by the combustion of dust or oil admitted into its chambers K K′. The hot products of combustion pass off through the tubes of the air-heater, while air delivered by a blower circulates around the tubes and is heated and then flows to the furnace to cause combustion of the fuel.

Illuminating-gas may be made by passing steam up through the bed of fuel, where it is decomposed, carbureting the resulting gas with oil or vapor admitted above the fuel in chamber K or K′, and combining and fixing the carbureted gas in contact with the hot brick-work in chamber C or C′. While steam is passed up through the bed of fuel steam and bituminous-coal dust may be blown in through pipes D *d* and be decomposed in chamber C. The bituminous dust will yield rich carbureted hydrogen gas, so that a fair illuminating-gas can be generated without admitting any oil; but if a gas of high candle-power is desired oil or oil-vapor is admitted either in chamber K or K′, and the gas is fixed by passage through the heated flues above. When the gases are passed up through the cupola, they are conducted off through pipe G′ at the top.

Superheated steam, carbon-dust, and oil or oil-vapor may be mixed together in combustion-chamber K above the fire and passed down through the fuel or up through the heated flues above and decomposed. Steam alone may be passed down through the heated flues in chambers C C′, and thus highly superheated, and then be mixed with carbon-dust and oil, or either one, in chamber K and the mixture passed down through the incandescent fuel for decomposition.

In the operation of heating up the cupola the supply of carbon-dust is properly regulated and adjusted to the air-supply, so that it may be completely burned. The supply of carbon-dust or oil is also adjusted to the steam-supply, so that the quantity of carbon shall be ample to produce decomposition of the steam. Any excess of carbon fed in with the steam will be deposited upon the bed of fuel and utilized when heating up the decomposing-chambers. My generators can thus be operated in a variety of ways suited to varying circumstances and conditions.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with two adjacent cupola gas-generating furnaces provided with annular dust-distributing flues, of a carbon-dust-feed box connecting with the dust-distributing flues of both cupolas, a spiral conveyer in said feed-box, and means for actuating and reversing the conveyer to feed the carbon-dust to either furnace at will, substantially as shown and described.

2. The combination, with a cupola gas-generating furnace, of the horizontal carbon-dust-supply pipe extended into the top chamber of said furnace and having its end turned up therein, and supply-pipes for steam and air connecting with said dust-pipe, substantially as and for the purpose described.

3. The combination, with a cupola gas-generating furnace having annular dust-distributing flues communicating with the combustion-chambers in said furnace, of a carbon-dust-feed box, a horizontal conveyer located in said feed-box, a horizontal pipe connecting said feed-box and conveyer with the said annular dust-distributing flues, a tubular air-heater connected with the outlet-pipe of the furnace for products of combustion and having separate vertical passages for gas and air,

a pipe leading from said air-heater to the annular dust-distributing flues of the cupola, the separate steam-superheater, the gas-take-off pipe connecting the cupola with the superheater, and a steam-pipe leading from the superheater to the cupola, substantially as shown and described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN L. STEWART.

Witnesses:
CHAS. MATHEWS, Jr.,
ELLA C. NEWBOLD.