(No Model.)

M. A. MORSE.

CUPOLA GAS GENERATING FURNACE.

No. 410,846. Patented Sept. 10, 1889.

Fig. 1.

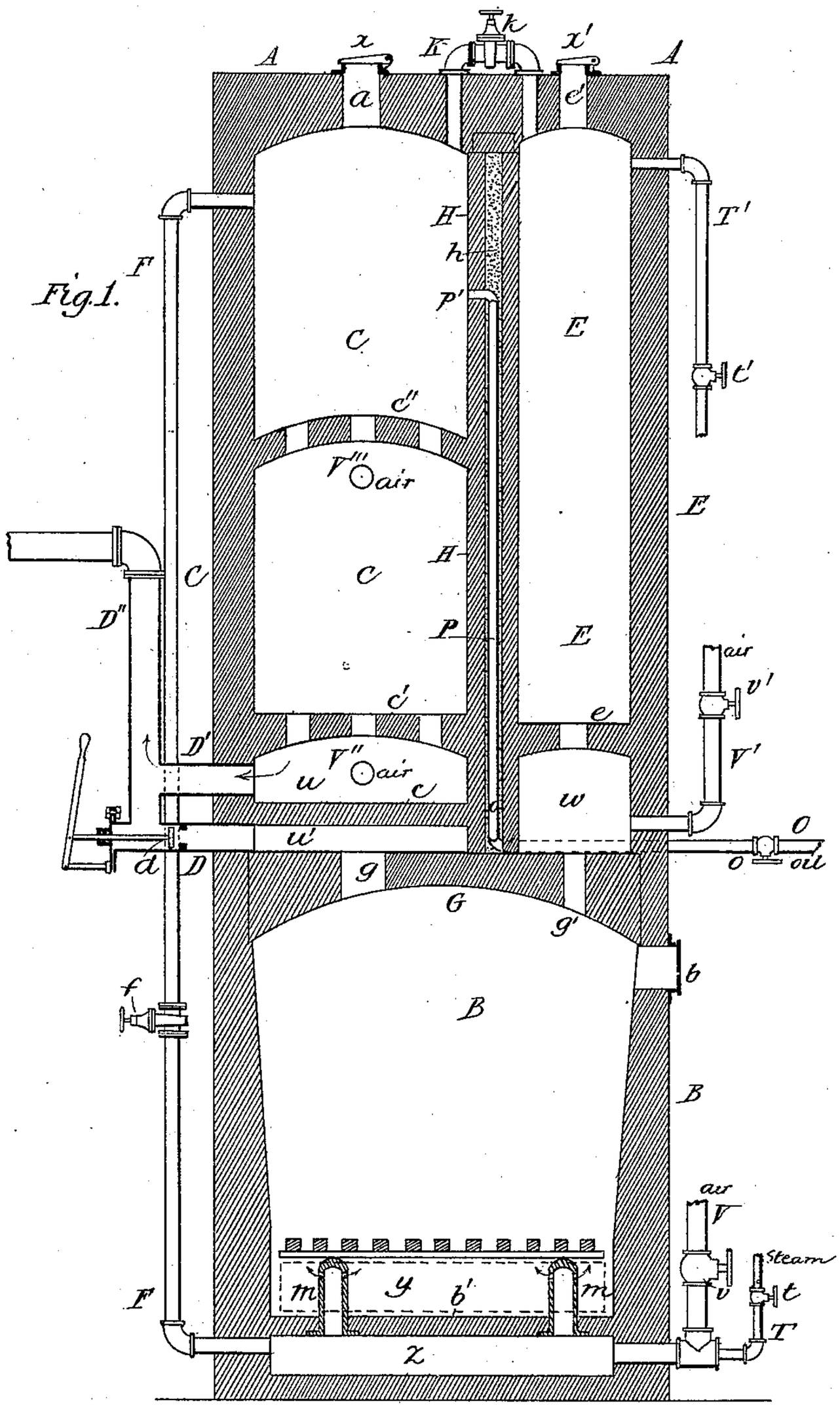
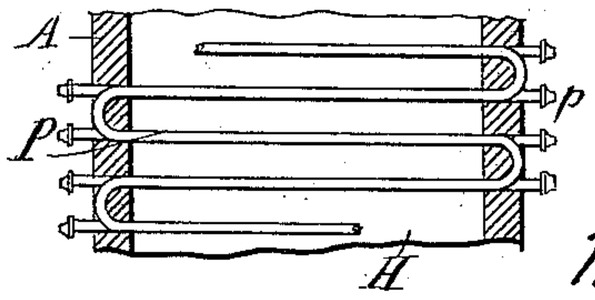


Fig. 2.



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CUPOLA GAS-GENERATING FURNACE.

SPECIFICATION forming part of Letters Patent No. 410,846, dated September 10, 1889.

Application filed April 2, 1889. Serial No. 305,697. (No model.)

To all whom it may concern:

Be it known that I, MARCELLUS A. MORSE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Cupola Gas-Generating Furnaces; 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 a cupola gas-generating furnace having a fuel-chamber at the base in which steam is decomposed, producing water-gas, and separate regenerative chambers at the top, one of which is for combining and fixing carbureted water-gas, and the other of which is for superheating steam preparatory to its decomposition in the fuel-chamber.

The objects of the invention are to provide for better storing and utilizing the heat or heating properties of the gaseous products arising from the fuel at the time it is blasted with air for heating it to incandescence by heating with such products both a gas-fixing chamber and a steam-superheating chamber; also, to provide for conveniently vaporizing hydrocarbon oil in pipes or channels arranged in a partition-wall between the gas-fixing and the steam-superheating chambers; also, to provide an improved hollow partition-wall having a packing of dry sand, whereby any cracks that may occur in the wall will be automatically filled with the sand and leakage of gas or steam from one chamber to the other thereby prevented; also, to provide for passing steam either up or down through the bed of incandescent fuel and conducting the resulting water-gas into the top of the gas-fixing chamber near to the place where the hydrocarbon oil or vapor is admitted.

My invention consists in the construction and arrangement of parts of the apparatus, as will be defined in the claims.

My improved generating-cupola is illustrated in the accompanying drawings, in which—

Figure 1 represents a vertical section, and Fig. 2 represents a sectional detail showing the preferred arrangement of the oil-vaporizing coil in the hollow partition-wall.

The cupola A is built of brick, and in practice is provided with a tight iron jacket in the usual manner, and is divided by a brick arch G into fuel-decomposing chamber B at the base, and the regenerative portion composed of chambers C and D, containing refractory brick-work or tile at the top.

The fuel-chamber is provided with a grate, and below this with chambers *y* and *z*, separated one from the other by horizontal partition *b'*. Chamber *y* serves as the ordinary ash-pit and chamber *z* as the receiving and distributing chamber for air and steam and outlet-chamber for water-gas.

Perforated distributing-channels *m*, opening at the bottom through partition *b'*, are arranged transversely in chamber *y*, and serve to support the grate and distribute air or steam through their lateral perforations under the grate, also to conduct water-gas down into chamber *z*, from which it is passed from pipe F to the top of fixing-chamber C.

The fuel-charging doors *b* are placed at the top of the chamber B.

The upper portion of the cupola is divided by the hollow vertical partition-wall E into the larger gas-fixing chamber C and the smaller steam-superheating chamber E. Chamber C is provided near its base with a solid horizontal partition *c*, forming chamber *u'* between it and arch G, also with perforated arch *c'*, forming combustion-chamber *u*. Another perforated arch *c''* is placed at about the middle of chamber C, and the arches *c' c''* serve to support the tile or other refractory brick-work. At the top chamber C is provided with outlet *a*, having lid *x*. Chamber E is provided near its base with a perforated arch or partition *e*, forming below it combustion-chamber *w* and at the top with escape-opening *e'*, having a closed lid *x'*. The large arch G is provided with openings *g g'* for conducting gaseous products from fuel-chamber B into chambers *u'* and *w*, opening *g* being made the larger, so as as to conduct a larger volume of gaseous products up into the larger chamber C. Chambers *u* and *u'* are connected by means of pipes D, D', and D'',

and one of these pipes, as D, is provided with a valve-box and a valve *d* for controlling the flow of gas. Pipe D″ in practice leads to a seal-box, (not here shown,) where its end dips into the sealing-liquid, as usual. Chambers C and E are connected at the top by pipe K, having valve *k*. An air-blast pipe V, having valve *v*, connects with chamber *z*, and a steam-pipe T, having valve *t*, also connects with chamber *z*, preferably through the air-pipe, as shown. Air supply-pipe V, having valve *v′*, connects with combustion-chamber *w*, and air-supply pipes V″ and V‴ connect with chamber C, respectively, below arches *c′* and *c″*, as shown. A steam-supply pipe T′, having valve *t′*, connects with the top of chamber E. Partition-wall H is made hollow, so as to form within it a narrow chamber or space *h*. Within this space is arranged the vaporizing-coil P, which may be arranged vertically with return bends, as shown in Fig. 1, or horizontally with connections outside of the furnace-walls, as shown in Fig. 2. With this latter arrangement of the coil the projecting ends of the tubes, which form it, are provided with removable screw-plugs, so that a cleaning-rod may be pushed through the tubes for removing any deposits that may obstruct them. An oil-supply pipe O, having valve *o*, connects with the lower part of the vaporizing-coil, and a pipe or nozzle *p′* admits vapor from the coil into the carbureting and fixing chamber C at any suitable height thereon, but preferably near the top, as shown. A number of nozzles *p′* may connect the coil at different heights with chamber C, so as to better mingle the oil-vapor with the water-gas admitted by pipe F. The vaporizing-coil having been properly placed in the space *h*, such space is entirely filled with fine dry sand or other dry granular material, so that in case cracks form in the brick wall the sand will run into them and close them up. In case of large cracks and a high heat being used, the sand would probably be melted, forming a glaze, which would completely fill and cement the cracks, making all tight and preventing leakage of gas or steam through the partition-wall. Dry sand alone, however, would sufficiently close the cracks to prevent leakage.

Cupola gas-generators have heretofore been constructed with the fuel-chamber and a single regenerative chamber in one vertical structure; but it has been found that the large volume of gaseous products given off from the fuel when it was heated to incandescence by blasts of air was much greater than could be advantageously used in heating the carbureting and fixing chamber, since only a moderately high temperature can be economically used in fixing carbureted gas. Therefore the fixing-chamber was heated to an injuriously high temperature, resulting in burning the hydrocarbon oil or vapor and forming lamp-black, or a large percentage of the gaseous products were allowed to escape and go to waste without being utilized. In either case the operation was wasteful and unnecessarily expensive. Now, in my present construction of cupola I provide the additional chamber E for superheating steam, so that when the fixing-chamber C has been properly heated the gaseous products are shut off therefrom, and are altogether burned in chamber E, which may be heated to a very high degree without injuring the steam which is to be passed through it. All the gaseous products arising from the fuel-chamber when the air-blast is on are thus utilized to the best advantage.

The operation is conducted as follows: Lids *x* *x′* and valve *d* being open, a fire is kindled on the grate, fuel gradually fed in, and the air-blast admitted till a deep bed of incandescent fuel is formed. The resulting gaseous products, containing a valuable percentage of carbonic oxide, are conducted through passages *g* *g′* and the connecting-pipes into combustion-chambers *u* and *w*, where they are burned by the admission of air through the pipes V′ V″. A second supply of air may be admitted by the pipe V‴, if necessary to complete the combustion in chamber C. Chamber C will be the most highly heated at the bottom and gradually to a decreasing temperature toward the top. When the fixing-chamber C is heated to the proper temperature, valve *d* and lid *x* are closed, and all of the gaseous products are then burned in steam-superheating chamber E till it is very highly heated. The fuel having been heated to the proper state of incandescence and the chambers C and E properly heated, as above described, the lid *x′* is closed and all the air-blast shut off. Valve *f* in pipe F is now opened, and steam is admitted by pipe T′ into the top of superheating-chamber E, in passing through which it is highly superheated. It is then passed down into and through the incandescent fuel in chamber B, where it is decomposed with very little loss of heat to the fuel. The resulting water-gas passes by pipe F into the upper part of carbureting and fixing chamber C, and at the same time hydrocarbon oil is admitted into the vaporizer P, where it is vaporized, and the resulting vapor passes by nozzle *p′* into chamber C. The hydrocarbon vapors immediately diffuse through the water-gas and combine with the hydrogen thereof, and the resulting illuminating-gas is fixed by passage down through chamber C, and it finally escapes by pipes D′ and D″ to the seal-box and washer. In this way a long run and a very large volume of gas may be generated before the temperature of the cupola is too much lowered for successful operation.

In the operation of the apparatus and after steam has been passed down to the fuel the direction thereof may be reversed. In this case valve *f* is closed and valve *k* open. The valve in steam-pipe T′ is closed and the valve in steam-pipe T opened. Steam is now admitted to chamber *z*, and is distributed by

perforated channels *m* into the base of the bed of the fuel. It is decomposed by passing up through the fuel, and the resulting water-gas passes up through chamber E and through pipe K into the top of chamber C, where it is carbureted, combined, and fixed, as before explained.

It has been found in practice that a larger yield of gas and better results are secured by passing the steam at different periods both up and down through the bed of incandescent fuel. When water-gas is passed down through the grate, it escapes through the perforated channels *m* into chamber *z*, from which it is conducted by pipe F, as before described.

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

1. In a cupola gas-generator, the combination of the fuel and decomposing chamber, the gas-fixing chamber and the steam-superheating chamber separated one from the other by a vertical partition and connecting at the bottom with such fuel chamber, a steam-supply pipe connecting with the top of the superheating-chamber, supply-pipes for gas and oil vapor, and a gas-outlet pipe connecting with the fixing-chamber, as and for the purpose described.

2. In combination with the fuel and decomposing chamber placed in the base of the cupola, the superheating and fixing chambers placed above, the arch at the top of the fuel-chamber, having openings for gaseous products leading into such superheating and fixing chambers, a valve-pipe connecting the chambers at the top, and an escape-pipe leading from the base of the fixing-chamber, as and for the purpose described.

3. In a cupola gas-generator, the combination, with the fuel and decomposing chamber, of the regenerative portion of the cupola placed above and divided by a vertical partition into a gas-fixing chamber and a steam-superheating chamber, each connecting at the bottom with the fuel-chamber and having at the top an escape-opening for products of combustion, and a closing lid and pipes for supplying air, steam, and oil or vapor to the chambers, and a gas-eduction pipe, whereby the heat of the gaseous products arising from the bed of fuel while it is being heated may be better stored and utilized for fixing gas and superheating steam, as described.

4. In a cupola gas-generator, the hollow partition-wall for separating the fixing-chamber from the superheating-chamber having its space filled with dry sand or equivalent material for closing cracks which may occur in the wall, as described.

5. In a cupola gas-generator, the combination, with the fuel and decomposing chamber placed in the base of the cupola, of the regenerative portion of the cupola placed above and divided by a hollow vertical partition-wall into a gas-fixing chamber and a steam-superheating chamber, and an oil-vaporizing pipe or coil arranged in the space of such wall, and a vapor-pipe leading therefrom into the fixing-chamber, for the purpose described.

6. In combination with the fuel-chamber, the fixing-chamber and superheating-chamber arranged and connecting, as described, a distributing-chamber *z*, arranged below the ash-pit, having air and steam supply pipes, a pipe for water-gas leading from chamber *z* to the top of the fixing-chamber, a valved pipe connecting the tops of the fixing and superheating chambers, and a steam-supply pipe connecting with the top of the superheating-chamber, as and for the purpose described.

7. In combination with the fuel-chamber of the cupola, the supply and distributing chamber *z*, arranged below the ash-pit, perforated channels *m*, communicating with such chamber and extending into the ash-pit, the steam and air supply pipes connecting with chamber *z*, and an escape-pipe for water-gas leading from such chamber to the fixing-chamber of the cupola, for the purpose described.

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

MARCELLUS A. MORSE.

Witnesses:
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H. C. HANSEN.