

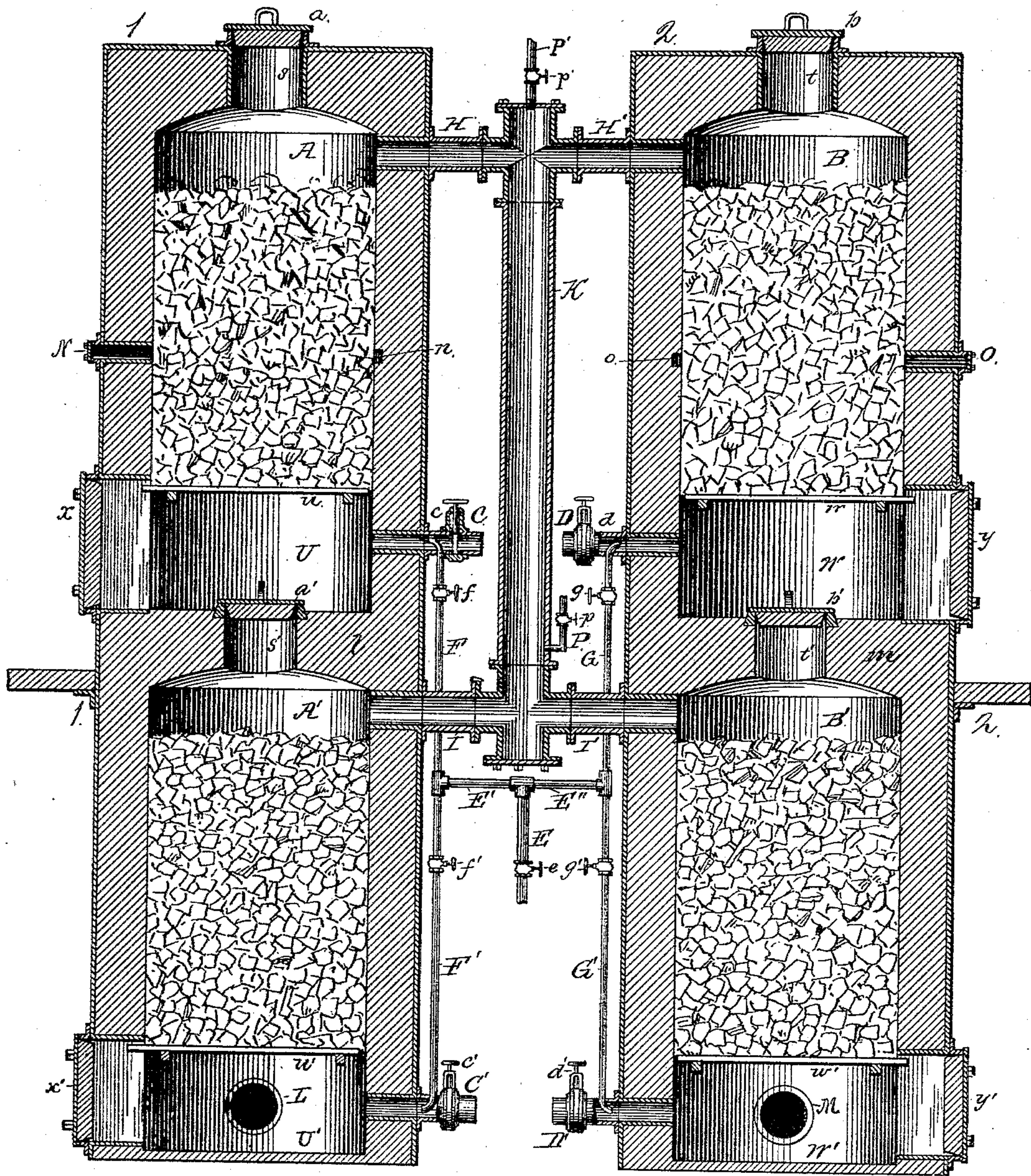
(No Model.)

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PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

No. 412,135.

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PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 412,135, dated October 1, 1889.

Application filed January 28, 1888. Serial No. 262,204. (No model.)

To all whom it may concern:

Be it known that we, THEODORE G. SPRINGER and MARCELLUS A. MORSE, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Process of and Apparatus for Manufacturing Gas; and we 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 a dry, well-decomposed, but rich producer-gas suitable for use as fuel or for motive power.

The object of the invention is to provide for converting the tarry vapors generated from bituminous coal or slack into fixed gas by conducting them through a suitable body or bed of incandescent or highly-heated fuel.

In carrying out our invention we reduce to coke one or more bodies of bituminous coal or slack of such coal, at the same time distilling the hydrocarbon vapors and gas therefrom at a low temperature and by a smothered combustion, and then discharge the coke thus produced into the fuel-chambers below, where it is maintained at a high temperature, utilizing such hot coke for superheating and fixing the producer-gas and combined tarry vapors passing off from the fresher bodies of coal or slack in the chambers above. We also mingle a hydrocarbon vapor or liquid—preferably crude petroleum—with the hot producer-gas and vapors distilled from the fresh bodies of coal, and pass the resulting carbureted mixture through bodies of highly-heated coke for converting all into a fixed gas. In this way we generate a producer-gas of high calorific value, which is practically dry and free from condensable matter, so that it may be distributed through mains and stored in a holder without any danger of condensation.

The particular matter constituting our invention herein will be defined in the claims.

Our improved apparatus is illustrated in the accompanying drawings, which represent a vertical section of a pair of cupola generat-

ing-furnaces and suitable connecting-pipes. We preferably use a pair of double or two-chambered cupolas having suitable connecting-pipes, so that gas may be passed from both of the upper coking and distilling-chambers down through either of the lower fixing-chambers. The furnaces 1 and 2 are built of brick, having a lining of fire-brick and covered with tight iron jackets in the usual manner. They are divided by arches *l* and *m* at about half their height into chambers A A' and B B'. The coking and distilling chambers A and B are provided with fuel-openings *s* and *t*, having tightly-closing lids *a* and *b*. The fixing-chambers A' and B' have formed in their arches *l* and *m* passages or fuel-openings *s'* and *t'*, closed by tightly-fitting lids *a'* and *b'*. Chambers A and A' are provided with ash-pits U and U' and grate-bars *u* and *u'*. Such ash-pits are provided with doors *x* and *x'*. Chambers B and B' are provided with ash-pits W and W', having grates *w* and *w'* and doors *y* *y'*. The coking and distilling chambers A and B are provided at points from one-quarter to one-third of their height above the grates with openings N and O, closed by suitable caps for the insertion of false or extra grate-bars for supporting the upper portions of the bodies of fuel while the lower coked or partly-coked portions are dropped down. Recesses *n* and *o* are formed in the walls opposite openings N and O, for receiving and supporting the inner ends of the false grate-bars. Air-inlet pipes C and C', having valves *c* and *c'*, connect with the ash-pits U and U' of cupola No. 1, and air-inlet pipes D and D', having valves *d* and *d'*, connect with the ash-pits W W' of cupola No. 2. A main steam-supply pipe E, having valve *e*, is provided with branches E' and E'', leading by suitable connections into both cupola-generators. A branch steam-supply pipe F, having valve *f*, leads into air-pipe C, and branch pipe F', having a valve *f'*, leads into the air-pipe C'. Branch steam-pipe G, having valve *g*, leads into air-pipe D, and branch steam-pipe G', having valve *g'*, leads into air-pipe D'. The steam-supply pipes preferably terminate in the air-pipes with inwardly-extending injector-noz-

zles, so as to act as injectors for forcing air into the fuel-chambers or ash-pits. These injectors, however, may be omitted and exhausters connected with the gas-take-off pipes, so as to draw air into the bodies of fuel as the gas is drawn off. In such case, however, steam-supply pipes should still be connected with the fuel-chambers. The coking and distilling chambers A and B are provided at the top with gas take-off pipes H and H', connecting with the large downwardly-extending pipe K, and the fixing-chambers A' and B' are provided with gas take-off pipes I and I', also connecting with the large pipe K, so that a free communication is provided between all the chambers of cupolas Nos. 1 and 2. An oil-supply pipe P, having a valve *p*, connects at any suitable point with pipe K, for spraying oil into the hot gas passing from the coking and distilling chambers A and B into one of the lower fixing-chambers A' or B'. The oil may be supplied from an elevated reservoir or may be forced by a pump into pipe K. Oil-vapors from a still or other generator may also be supplied to pipe K and mingled with the hot producer-gas. The oil might also be discharged directly upon the tops of the bodies of fuel in the coking and distilling chambers A and B and the vapors passed off with the gaseous products from such chambers. The gas-take-off pipes L and M lead, respectively, from ash-pits U' and W' to the holder or to the place of immediate use, such as metallurgic or steam-boiler furnaces. A device consisting of a lever mounted on a wheel may be used for elevating the lids A' and B' and removing them from the ash-pits U and W when hot coke is to be discharged into chambers A' and B'.

The operation of the apparatus for generating producer-gas is as follows: Fires are first kindled in the fixing-chambers A' and B', and supplied with coke or other suitable fuel till deep bodies of incandescent fuel are formed, the lids *a'* and *b'* and the ash-pit doors *x* and *y* being open. Fires are also kindled in the coking and distilling chambers A and B, and they are at first fed with coke, which is allowed to burn by natural draft until it is well ignited, the lids *a* and *b* being left open. After the bodies of fuel are well ignited and heated to incandescence the coking and distilling chambers A and B are well charged with a low grade of bituminous coal or slack, such as generally used in gas-producers, and the lids and ash-pit doors of all chambers are closed. The air-inlet pipes C D D' are now opened and the steam-injectors started into operation, while the valve of air-pipe C' and that of steam-pipe F' are closed and the valve of gas-take-off pipe L is opened. The currents of air and steam are now passed up through the bodies of fuel in chambers A, B, and B', resulting in the generation of producer-gas and also coking and distilling the coal in chambers A and B. The producer-

gas containing oily and tarry vapors passes from chambers A and B into pipe K, and thence into the top of fixing-chamber A', and down through the body of incandescent or highly-heated coke contained therein, whereby the hydrocarbon vapors and any free steam are converted into fixed producer-gas and water-gas, and whereby any carbonic acid in the producer-gas is changed to carbonic oxide. The resulting fixed or dry producer-gas passes off through pipe L to the holder or any furnace for immediate use. After running in this manner for from five to ten minutes the air and steam are shut off from chamber B', the valve of the gas-take-off pipe M is opened, and the valve of gas-take-off pipe L is closed. Valves *f'* and *c'* are opened, so as to inject steam and air into the fuel in chamber A', where combustion takes place, the resulting products of which pass out through pipe I and mingle with the gases and vapors from the coking and distilling chambers A and B. These mixed gases and vapors then pass down through the body of incandescent or highly-heated fuel in chamber B', where they are converted into fixed gas, which is conducted off from the base of ash-pit by pipe M. At the end of from five to ten minutes the valves are again reversed and the gases and vapors are passed through the body of fuel in chamber A', where they are fixed and conducted off, as before explained. The distilling and coking chambers A B are maintained at a comparatively low temperature, and the coal therein is coked and distilled by a smothered or low combustion by admitting a limited and controlled amount of air. It is important to conduct the coking and distilling operation at a low temperature, so as to prevent the bituminous coal or slack from melting and running together into coherent cakes or crusts, which greatly interfere with the operation and practically prevent the formation of coke which can be fed down and discharged into the fixing-chambers below. The fixing-chambers A' and B', on the contrary, are heated to a comparatively high temperature in order to properly fix the vapors and gases from the coking and distilling chambers. By feeding hot coke from the coking and distilling chambers to the fixing-chambers we not only utilize the heat of such coke, but are able to blast it with air and heat it to a high temperature without caking or crusting, as would be the case with bituminous coal.

By our process we are able to use cheap bituminous coal and convert it all into fixed commercial gas by first coking and distilling the coal with a smothered combustion at a low temperature and then converting the oily and tarry vapors and other products into fixed gas by passage through the coke first produced and heated to a high temperature in a separate chamber. After making gas for about two hours the operation is suspend-

ed, and the false grate-bars are inserted through opening N in chamber A, so as to support the body of fuel above, ash-pit door X is opened, and, after removing the ashes, the lid *a'* is removed and grate U is let down, so as to dump the superincumbent coke below the false grate-bars into ash-pit U and into chamber A'. All the coke dumped into ash-pit U is discharged into chamber A'. Then the lid *a'* is replaced, grate U secured in position, ash-pit door X is closed, and the false bars are withdrawn through opening N, permitting the fuel above to descend upon the grate U. Fresh fuel—such as low-grade bituminous or slack coal—is now fed into chamber A, and it is closed, and the generation of gas is continued, as above explained. At the end of about two hours more or other suitable period, when the coal is suitably coked in chamber B, and when chamber B' needs to be replenished with fuel, false grate-bars are inserted through opening O, door Y is opened, the ashes are removed, and lid *b'* is lifted, and the coked coal below the false grate-bars is allowed to drop into the ash-pit W, from which it is fed into chamber B'. Fresh bituminous coal or slack is fed into chamber B. Then the doors, lids, and grate-bars are adjusted as before explained, and the operation of generating gas is resumed. Chambers A and B may be supplied with fresh fuel at any time without suspending the operation of making gas. At the time the manufacture of gas is suspended ashes and clinkers may be removed from the bases of chambers A' and B' and their ash-pits cleaned.

During the operation of generating producer-gas a hydrocarbon liquid—such as crude petroleum—may be admitted by pipe P or P' into large gas-pipe K, and mingled with the hot producer-gas and passed with such gas down through one of the bodies of incandescent fuel in chamber A' or B', and be thus converted into a fixed gas, adding a large percentage of carbureted hydrogen to the producer-gas, thus greatly increasing its calorific value. This gas is well suited for heating purposes in metallurgic or glass furnaces, in pottery-kilns, also for domestic heating and cooking, and for running gas-engines, &c.

An exhauster may be connected with the gas-take-off pipes leading from the ash-pits of chambers A' and B', and air be thereby drawn into the chambers of the cupolas and the gas drawn off therefrom. In case exhausters are used instead of steam-injectors for supplying the chambers with air, steam-supply pipes are connected with the fuel-chambers, so as to admit a small proportion of steam with air for making some water-gas. The air may also be supplied to the ash-pits or other portions of the generating or fuel chambers by suitable blowers in the well-known manner.

Having thus described our invention, what

we claim, and desire to secure by Letters Patent, is—

1. The process of manufacturing gas which consists in charging bituminous coal or slack upon a body of heated fuel, causing smothered combustion and distillation thereof by admitting a limited supply of air, or air and steam, and converting it into coke, at suitable intervals discharging the hot coke into a fixing-chamber and highly heating it, and passing the gaseous vapors produced in the coking-chamber through the body of highly-heated coke in the fixing-chamber for converting them into dry fixed gas.

2. The process of manufacturing gas which consists in charging bituminous coal or slack upon a body of heated fuel, causing smothered combustion and distillation thereof by admitting a limited supply of air, or air and steam, and converting it into coke, at suitable intervals discharging the hot coke into a fixing-chamber and highly heating it, enriching or carbureting the gaseous vapors produced in the coking-chamber with hydrocarbon oil or vapor, and passing the mixture through the body of highly-heated coke in the fixing-chamber for converting it into dry fixed gas.

3. A cupola-generator divided into upper and lower fuel-chambers, each having air and steam supply pipes, the dividing-partition being provided with an opening and tight-fitting lid, in combination with the gas-conducting pipe leading from the top of the upper chamber into the top of the lower chamber, and the gas-take-off pipe leading from the lower chamber, for the purpose described.

4. A gas-generating cupola divided by partition 1, having a passage and tight-closing lid, into upper and lower fuel-chambers A A', each provided with an ash-pit and grate, and each having an air and steam supply pipe connecting with its ash-pit, and chamber A, having openings above its grate for the insertion of false bars, in combination with gas-conducting pipe leading from chamber A to chamber A', and the gas-take-off pipe leading from chamber A', as and for the purpose described.

5. Two cupola gas-generators divided by horizontal partitions, the arches having openings and lids, into upper and lower fuel-chambers, in combination with gas-conducting pipes leading from the top of each of the upper chambers, and each pipe connecting to a flue which leads into each of the lower chambers, and means for supplying all of the chambers with air and steam, whereby producer-gas and vapors generated in two of the upper chambers and either of the lower chambers may be passed through the body of fuel in the other of the lower chambers for producing a fixed gas.

6. Two cupola gas-generators divided into upper and lower fuel-chambers, as described, in combination with gas-conducting pipes

leading from the tops of the four chambers
and connecting with a vertical pipe having
connected with it an oil-supply pipe, a gas-
take-off pipe leading from each of the lower
5 fuel-chambers, and supply-pipes for air or
steam connecting with the chambers, as and
for the purpose described.

In testimony whereof we affix our signa-
tures in presence of two witnesses.

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MARCELLUS A. MORSE.

Witnesses:

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