(No Model.)

J. HENDERSON.

APPARATUS FOR THE COMBUSTION OF GASEOUS FUEL.

No. 315,142. Patented Apr. 7, 1885.

Fig. 1

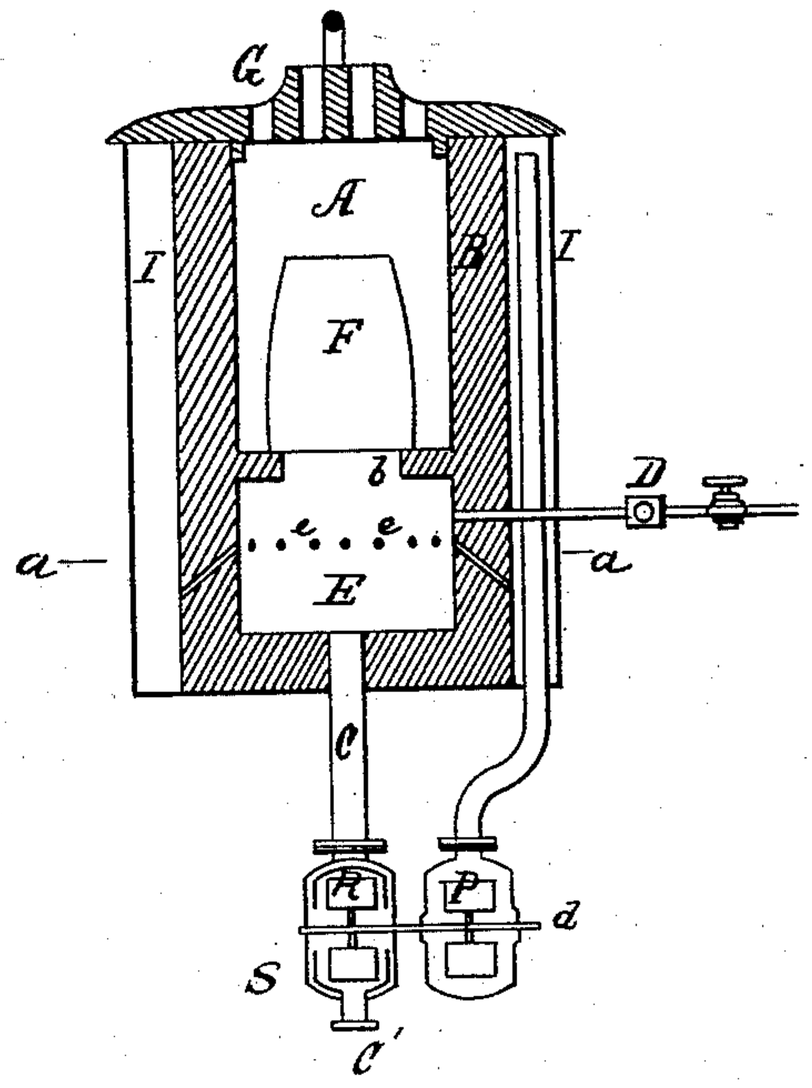


Fig. 2

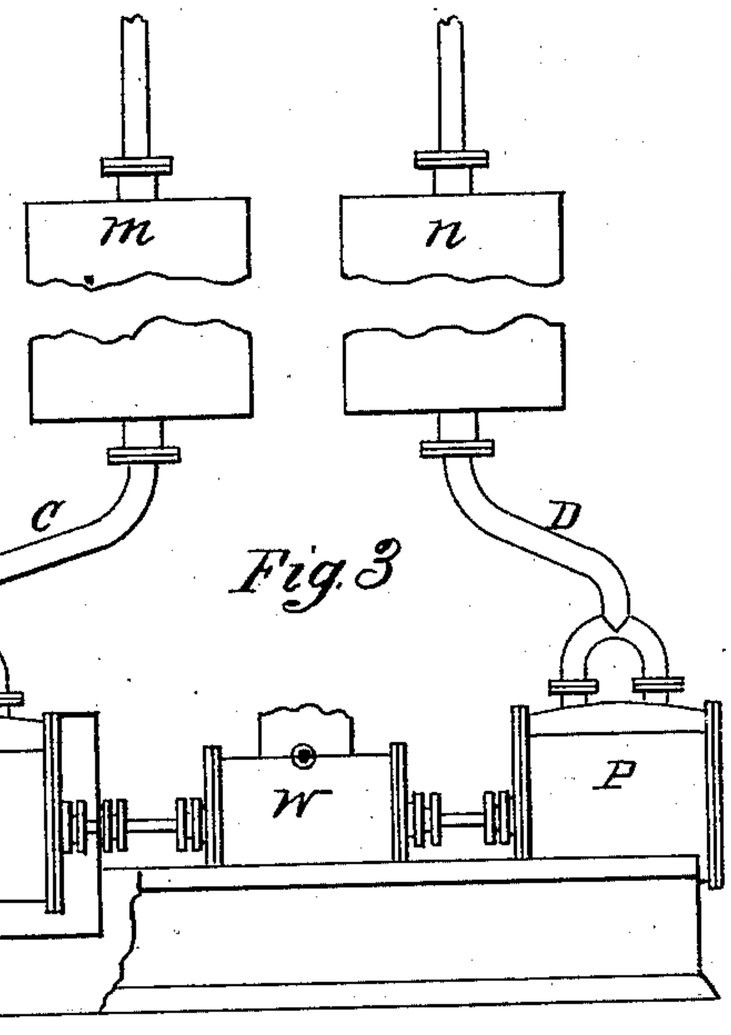
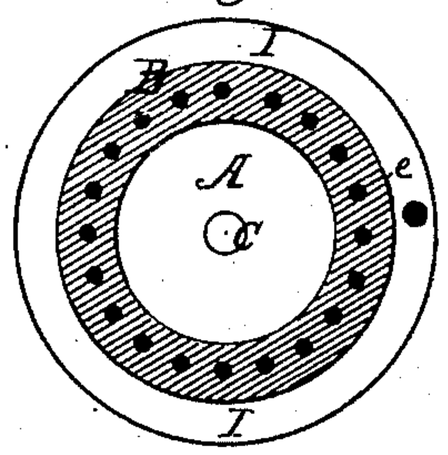


Fig. 3



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APPARATUS FOR THE COMBUSTION OF GASEOUS FUEL.

SPECIFICATION forming part of Letters Patent No. 315,142, dated April 7, 1885.

Application filed March 11, 1881. (No model.)

To all whom it may concern:

Be it known that I, JAMES HENDERSON, formerly of the city, county, and State of New York, now residing in Bellefonte, in the county of Centre and State of Pennsylvania, have made an invention of certain new and useful Improvements in Apparatus for the Combustion of Gaseous Fuel, which are applicable more particularly to the use of natural combustible gas.

The following, in connection with the accompanying drawings, is a full, clear, and exact description and specification of the same.

The said invention consists of certain combinations of the furnace in which the heat is to be applied with devices for measuring the gas and for measuring and heating the air for burning the gas, and for utilizing the initial pressure of natural gas. These combinations are recited in the claims at the close of this specification, and more or less of them may be used as circumstances render expedient. In order that the said combinations may be fully understood, I will proceed to describe the construction and operation of what I believe to be the best form of apparatus in which I have embodied my invention previous to the date of this application.

Figure 1 of the accompanying drawings represents a central section of one form of the said apparatus. Fig. 2 represents a horizontal section of the furnace at the line *a a* of Fig. 1. Fig. 3 represents a view of a modification of the apparatus for measuring the gas and air.

The furnace of the apparatus represented in the accompanying drawings has a combustion-chamber, A, in which the pot or crucible F, or other article is heated, and when a pot or crucible is used it is conveniently supported by lugs or projections *b*, which are separated by spaces through which the gaseous fuel can pass. The upper end of this combustion-chamber is closed by a cover, G, which is perforated with openings for the escape of the spent gases. The combustion-chamber has beneath it a mixing-chamber, E, in which the gas is mixed with the air required for its combustion. The air enters this mixing-chamber through tuyeres *e*, formed in the wall of the chamber, and these tuyeres are, by preference, inclined upward, so that the air issues from them in an upward direction toward the combustion-chamber. The gas is conducted to the mixing-chamber by a gas-pipe, C.

In order that the gas and the air may both be measured previous to their mixture, so that the required quality of flame, whether reducing, oxidizing, or neutral, may be produced, a gas-meter, R, and an air-meter, P, are provided, and the gas and air are caused to pass, respectively, through the gas-meter and the air-meter on their way to the mixing-chamber E, the gas-meter R being combined with the mixing-chamber and with the combustion-chamber of the furnace through the intervention of the gas-pipe C, and the air-meter P being combined with the same two devices through the intervention of the air-pipe I. The gas-meter and the air-meter are combined with each other, (in this case by a shaft, *d*, common to both,) so that the two run at definite speeds and deliver the proportionate quantities of gas and air required to produce the quantity of flame required.

In order that the air may be heated previous to its admission to or mixture with the gas for the purpose of producing intense heat, the furnace-wall B is inclosed in a jacket, I, and the air is caused to pass through this jacket on its way to the tuyeres *e*, so that the air passing through the jacket is heated by contact with and radiation from the heated wall of the furnace. The wall of the furnace and its surrounding jacket thus constitute a heating device for heating the air.

Heating the air is quite important, as it insures complete combustion and highest temperatures from the combustion of natural combustible gas without the formation of solid gas carbon, and the lower temperatures and waste of fuel incidental to incomplete combustion, which occur when air that is not heated is used, as has been heretofore proposed.

The air-meter P (represented in Fig. 1) is an ordinary fan, which delivers a definite quantity of air, according to its speed of revolution. The gas-meter may also be an ordinary fan when the initial pressure of the gas is low—say at about the pressure of the atmosphere—

and the gases not employed to drive the air-meter. Its size is then so proportioned to that of the air-meter P that the former will deliver the required quantity of gas, while the air-meter delivers the quantity of air required for the combustion of the gas according to the quality of flame required. Enough greater pressure is required in the gas-meter than in the air-meter to give the required power to force the ten to fifteen times greater volume than there is of gas, less air being required for marsh-gas (CH_4) than for olefiant, (CH_2,) or gas more highly charged with carbon, when perfect combustion is required, in which cases the ordinary water-gas meter is not available for this use, as the pressure of the air will force the water from the meter.

It is well known, however, that natural combustible gas has generally or frequently a high initial pressure, amounting sometimes to as much as seventy pounds to the square inch. In order that this pressure may be utilized, the gas-meter R is so constructed as to be what may be called a "gas-turbine," its fan-wings being inclosed by a double case, S, which is connected with the gas-supply pipe C′, so that the gas entering the fan-case exerts a pressure upon the fan-wings and causes the same to revolve, while the gas, after expending a part of its force upon the fan-wings, issues by the central openings or eyes of the inner case into the outer case, and passes thence to the gas-pipe C. The initial pressure of the gas thus causes the fan-wings to revolve, and as the fan-wings of the gas-meter R are connected by the shaft *d* with the fan-wings of the air-meter P, the air-meter is driven by the gas-meter, and the natural initial pressure of the gas is utilized in supplying the air required for its combustion.

The gas from the gas-meter enters the mixing-chamber E on its way to the combustion-chamber A, and as this mixing-chamber is of large capacity it affords space for the expansion of the gas to so low a pressure that it does not prevent the entrance of the air, (through the tuyeres *e*,) even though the air has a much lower initial pressure than that of the gas entering the gas-meter. The large mixing-chamber E thus constitutes an expansion-chamber for the gas used.

In place of using rotary air and gas meters, such as are represented in Fig. 1, I sometimes use reciprocating air and gas meters, such as are represented in Fig. 3, the air being measured by one cylinder, P, and the gas being measured in a second cylinder, R, each of which is fitted with a piston and with a slide-valve similar to those of an ordinary steam-engine; or the meter may be fitted with ordinary check-valves. In the form represented in Fig. 3 these meters are adapted to operate upon gas and air of the atmospheric pressure, and the two are driven by means of an intermediate steam-cylinder, W, which is fitted with a slide-valve and valve-operating devices similar to those of ordinary steam-pumps. When these reciprocating meters are used with natural gas having a high initial pressure, the intermediate steam-cylinder may have the gas admitted directly to it, and its exhaust-pipe may be connected with the furnace, the third cylinder, P, being then omitted. The cylinder W and the cylinder R are in such case made of the proper proportionate areas for the gas and air, and the gas is not only measured, but its initial pressure is utilized to supply the air required for its combustion.

When using reciprocating meters, I prefer to interpose a regulating-vessel, *m* and *n*, in the passage from the meter to the furnace, so as to equalize the flow of the gas and air, and the area of such regulating-vessel should be at least ten times that of the meter it operates with. In cases in which it is desirable to use in the same furnace at different times different temperatures, and to change the chemical nature of the flame from a reducing to a neutral or oxidizing flame, the meters may be driven by belting or gearing to give differential speeds, or they may be driven by separate prime movers.

When the gaseous fuel is combustible gas (consisting mainly of carbonic oxide) derived from coal in a gas-producer, I apply to the furnace a supplemental gas-pipe, D, for supplying ordinary lighting-gas for starting the furnace.

The invention is not restricted to the particular form of furnace represented, as this may be changed to suit the purpose required. The construction of the air-heating device also may be varied. Thus, for example, the air may be heated in pipes which are so arranged as to be heated by the spent gases issuing from the combustion-chamber of the furnace.

The invention also is not restricted to the peculiar forms of meters represented in the drawings.

The relative sizes of the gas and air meters will depend upon circumstances—such as the initial pressure of the gas, the quality of the gas, and the quality of the flame required; and when flames of different qualities are required with the same apparatus I fit the supply-pipes with stop-cocks or valves, so that the supply of air or of gas may be partially choked, to reduce the volume of one or the other and vary the proportions in which they are mixed.

It is preferred to regulate the pressure of the gas by storing it in gasometers or other suitable reservoirs connected by a pipe with the gas-meter. I do not wish to be understood as limiting my invention to mixing the air and gases before they enter the combustion-chamber, as good results may be obtained by their admixture in the combustion-chamber.

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

1. The combination, substantially as before set forth, of the combustion-chamber of the furnace, air-heating devices, a gas-meter for measuring the gas, and an air-meter for meas-

uring air, connected with said furnace, whereby the gas to be burned and the air in a heated condition required for its combustion are both supplied in measured quantities to the said combustion-chamber.

2. The combination, substantially as before set forth, of the combustion-chamber of the furnace, the gas-meter, and the air-meter, both connected with said furnace, and the gas-expansion chamber arranged between the gas-meter and the combustion-chamber of the furnace, whereby gas under strong initial pressure may be permitted to expand before it is mixed with the air at a lower initial pressure.

3. The combination, substantially as before set forth, of the gas-furnace, the pressure gas-meter, and the air-meter driven by said pressure gas-meter, whereby the initial pressure of natural gas is utilized in supplying a measured quantity of air for its combustion.

Witness my hand this 9th day of March, A. D. 1881.

JAMES HENDERSON.

Witnesses:
W. L. BENNEM,
WILLIS MCDONALD.