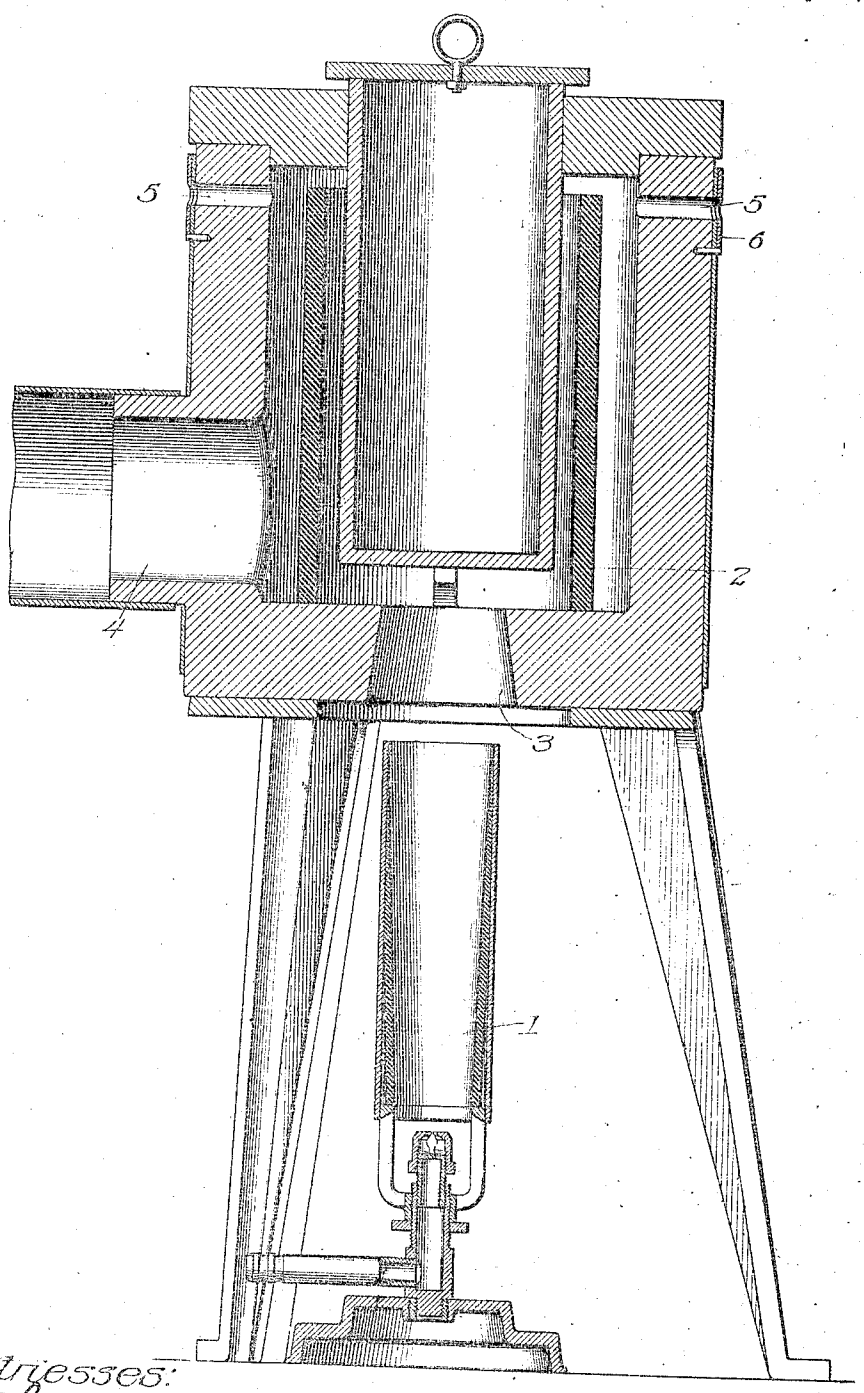
C. K. HARDING.

PROCESS FOR BURNING GASEOUS FUEL.

APPLICATION FILED MAY 2, 1912.

1,067,983.

Patented July 22, 1913.



Witnesses:
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UNITED STATES PATENT OFFICE.

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PROCESS FOR BURNING GASEOUS FUEL.

1,067,983. Specification of Letters Patent. Patented July 22, 1913.

Application filed May 2, 1912. Serial No. 694,761.

To all whom it may concern:

Be it known that I, CHARLES KNOX HARDING, a citizen of the United States, and a resident of Woodlawn, city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Processes for Burning Gaseous Fuel.

My invention relates generally to the production of heat by the combustion of a mixture of combustible gases and air, especially to the production of a more rapid or intensified combustion than can be produced with the ordinary atmospheric burner or Bunsen flame.

Great difficulty has heretofore been encountered in maintaining a flame with the theoretically most desirable mixture of gas and air, because such a mixture is explosive and the explosion is rapidly propagated back through the mixture from the point of ignition, and if the velocity of flow of the mixture is sufficient to overcome this the flame of burning gas is carried away and blown out.

A process of burning an explosive mixture has been discovered, based on the fact that the rate of propagation of the back igniting wave was much less in a cold mixture, so that the cold explosive mixture could be passed at a high velocity into a highly heated zone where its inflammability would be increased and its velocity reduced so that a flame could be maintained at this zone.

The object of my invention is to convert chemical energy of gaseous fuel into radiant energy by means of a solid structure which chemically reacts in the oxidization of the gaseous mixture to produce flameless catalytic combustion, such solid structure thus receiving and radiating the heat liberated and enables a higher heat intensity to be utilized and applied than would be the case where the combustion or oxidization took place between the gaseous elements themselves in the form of flame.

I have discovered that a comparatively inexpensive catalytic structure can be made composed principally of the oxids of the radio active elements thorium and uranium that will produce and maintain flameless combustion when sufficiently heated.

My invention further takes advantage of the fact that flameless combustion can be conveniently applied directly to heat the flowing combustible mixture, so that said mixture will have its volume increased and its density reduced in such a way as to greatly increase the kinetic energy of the flowing mixture.

As the intensity of temperature depends upon the velocity at which the mixture is supplied to the combustion surface with flameless combustion, there is no objection to employing the highest velocities it is possible to produce.

My process also permits considerable heat and kinetic energy to be obtained from a preliminary mixture containing only a portion of the necessary air for complete combustion and permits the addition subsequently of further quantities of air for the complete combustion of the mixture.

The accompanying drawings illustrate a form of apparatus which may be employed in carrying out my improved process.

The catalytic structures 1 and 2 shown in the drawings may be made of refractory material platinized or treated with any suitable catalytic material such as described in my United States Patents No. 803,534, Oct. 31, 1905 and No. 969,368 Sept. 6, 1910.

The figure shows a section through my improved burner as applied to a muffle furnace.

The drawings illustrate the diverging tubular lining 1 of catalytic material carried by the burner in position to be acted on and heated by the gaseous mixture passing through the burner. The furnace as shown is provided with the cylinder 2 of catalytic material which surrounds the muffle. In operation the rapidly flowing stream of hot gaseous mixture ascends from the top of the catalytic lining 1 without being inflamed, and passes through the converging opening 3 together with an additional quantity of air into the furnace. The mixture then passes up the annular space surrounding the muffle and in contact with the interior of the catalytic cylinder 2 which is adapted to be heated to a high temperature by catalytic combustion without inflaming the mixture, which is moving at a high velocity through said annular space.

The annular space between the outside of the catalytic cylinder and the inner walls of the furnace, and connecting the top of the tube 2 with the outlet 4 near the bottom of the furnace has a sufficiently large cross sectional area so that the velocity of the flow-

ing mixture in such space is reduced and a flame may be maintained therein.

Additional air inlet openings 5—5 provided with the perforated controlling ring 6, are arranged to supply additional air to complete the flame combustion in the outer chamber of the furnace. The outlet 4 may be provided with a pipe to carry off the products and increase the draft.

I have discovered that thorium oxid at temperature between 1000 F. and 2000 tends to form a peroxid $Th._2O_7$. The chemical reaction $Th._2O_4$ plus O_3 equals $Th._2O_7$ is endothermic but takes place between the temperatures mentioned. The reaction is also reversible and the peroxid is decomposed at temperatures above 2000. I have discovered that an admixture of uranium oxid seems to act probably by giving the body more radiating capacity to keep the temperature of the mixture down to the proper range. The commercial importance of my invention is based on the fact that mixtures of thorium and uranium oxids manifest very pronounced and active catalytic properties, especially in promoting oxidization when supplied with atmospheric oxygen promoting and producing chemical interchange of the elements without being permanently altered. This improved catalytic structure forms the subject matter of a separate pending application for United States Patent, Serial No. 684,636, filed March 18, 1912; but it makes possible the practical use of the herein described process and apparatus.

Having now described my invention, what I claim is,—

1. The process of burning gas which consists of producing a flowing current of a combustible gaseous mixture, passing the mixture in contact with a heated catalytic agent without effecting ignition, thereby heating the catalytic agent and the mixture, confining and directing the flowing current of the mixture while it is being heated and expanded so as to increase the velocity of the flowing mixture, and subsequently burning the same.

2. The process of burning gaseous fuel, which consists of producing a flowing current of combustible gas, mixing air with the flowing current of gas, passing the flowing mixture in contact with a heated catalytic agent, thereby heating the catalytic agent and the flowing mixture by the partial combustion of the mixture, confining and directing the flowing current of the mixture while it is being heated so that the increased volume and energy of the mixture will increase the velocity of the flowing current of the mixture, and subsequently burning the mixture.

3. The process of burning gaseous fuel which consists of producing a flowing current of combustible gas, mixing air with the flowing current of gas, passing the flowing mixture in contact with a heated catalytic agent, thereby heating the catalytic agent and the flowing mixture by the partial combustion of the mixture, confining and directing the flowing current of the mixture while it is being heated so that the increased volume and energy of the mixture will increase the velocity of the flowing current of the mixture, introducing an additional quantity of air to the mixture, and subsequently burning the mixture.

4. The process of burning gaseous fuel, which consists of producing a flowing current of a combustible gaseous mixture, passing the mixture in contact with a heated catalytic agent along the path of the flowing current, producing heat by the flameless combustion of a part of the gaseous mixture in contact with said first catalytic agent, and passing the uninflamed mixture to one or more subsequent separate distant points, each provided with a catalytic agent for burning successive portions of the flowing mixture.

In testimony whereof, I have hereunto set my hand this 30th day of April, 1912.

CHARLES KNOX HARDING.

Witnesses:

C. F. MILLER,

J. B. BODFISH, Jr.