No. 611,914. Patented Oct. 4, 1898.

O. KERN.

INCANDESCENT GAS BURNER.

(Application filed Feb. 25, 1898.)

(No Model.)

Fig. 1.

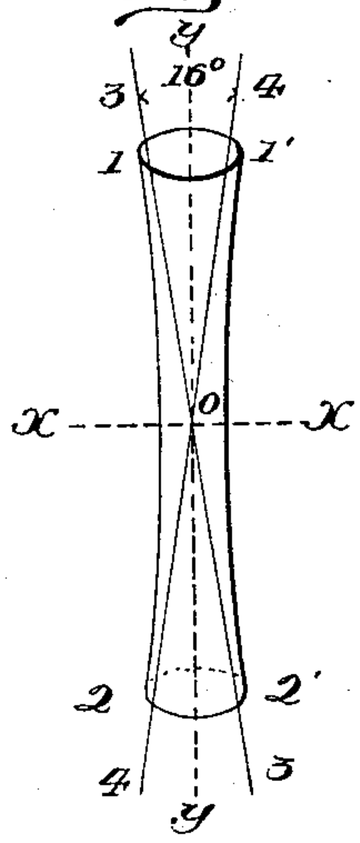


Fig. 2.

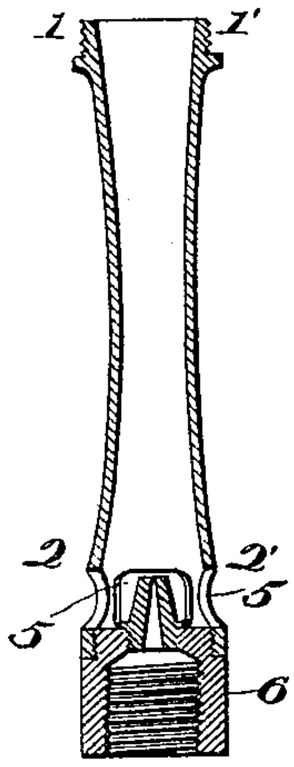


Fig. 3.

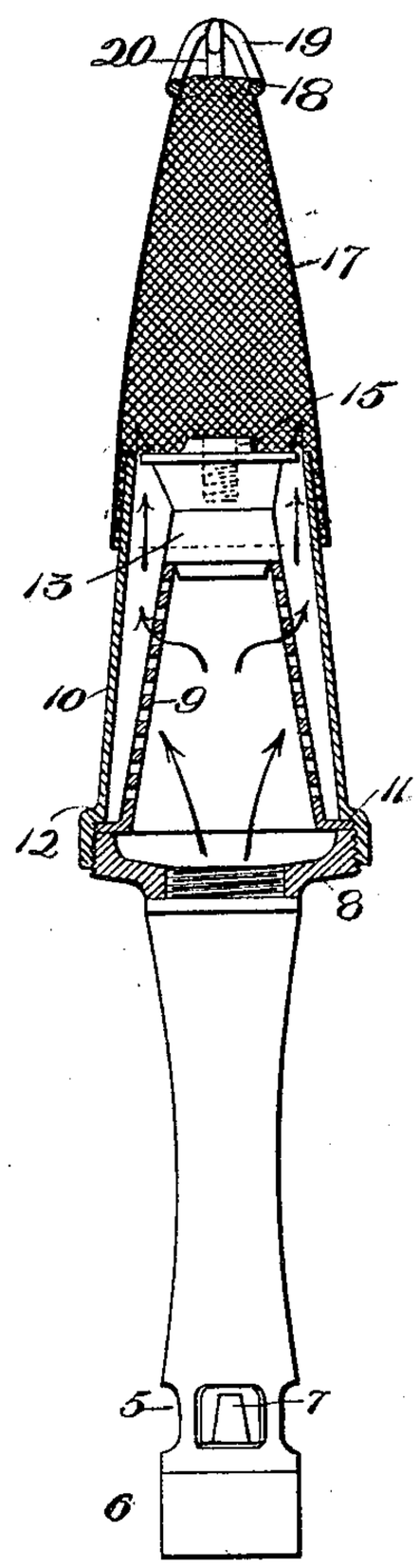
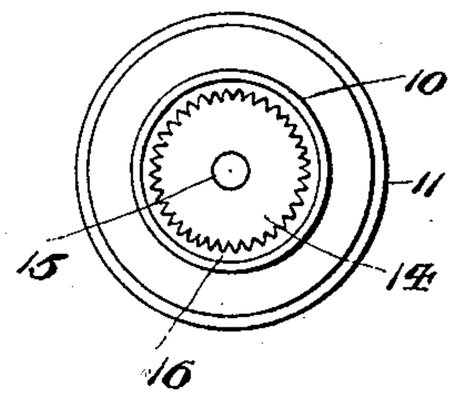


Fig. 4.



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UNITED STATES PATENT OFFICE.

OTTMAR KERN, OF PARIS, FRANCE.

INCANDESCENT GAS-BURNER.

SPECIFICATION forming part of Letters Patent No. 611,914, dated October 4, 1898.

Application filed February 25, 1898. Serial No. 671,594. (No model.)

To all whom it may concern:

Be it known that I, OTTMAR KERN, a citizen of the United States of America, and a resident of Paris, in the Republic of France, have invented certain new and useful Improvements in Incandescent Gas-Burners, of which the following is a specification.

My invention has reference to incandescent gas-burners designed to raise a mantle or hood of refractory material to a state of hyperincandescence by a self-burning mixture of air and illuminating-gas or air and natural gas.

The present invention is in the nature of an improvement upon the incandescent gas-burner for which Letters Patent of the United States No. 574,805 were granted to me on January 5, 1897.

In my aforesaid patent I have shown, described, and claimed as an element of the incandescent gas-burner an improved Bunsen burner composed of an upwardly-converging hollow mixing-cone and an upwardly-diverging hollow suction-cone, and while such Bunsen burner gave results that were far superior to those of Bunsen burners of ordinary construction I have ascertained that the self-burning mixture of gas and air is more completely realized when the contour of the tube of the burner is changed in accordance with my present invention.

My present improvement therefore relates mainly to the particular contour of the interior of the Bunsen burner, but also extends to other portions of the burner, as will be hereinafter more fully explained with reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrating the principle upon which the construction of the improved Bunsen burner is based. Fig. 2 is a longitudinal section of a Bunsen burner constructed in accordance with this principle. Fig. 3 represents the incandescent gas-burner, showing the Bunsen-burner portion in elevation and the upper portion of the device in longitudinal section; and Fig. 4 is a top plan view of the burner with the mantle of refractory material removed.

Like letters and numerals of reference indicate like parts.

Referring to Fig. 1, the curves 1 2 and 1′ 2′ represent the two branches of a hyperbola, the coördinates of which are indicated at $x\,x$ and $y\,y$ and the asymptotes by 3 3 and 4 4. If such hyperbola is rotated about the axis $y\,y$ it generates a hyperboloid, such as indicated in Fig. 1, and I have found that the geometrical characteristics of such hyperboloid have a particular physical significance, which becomes important when utilized in the construction of a Bunsen burner for an incandescent gas-burner. The geometric characteristic of such hyperboloid here considered is that the increase of area of its transverse cross-sections is directly proportional to the square of the distance of that cross-section from the point of intersection O of the coördinates, which will hereinafter be referred to as the "center" O—that is to say, if a cross-section be made at the center O and another cross-section at any other point of the ordinate $y\,y$, then the difference of the areas of these two cross-sections is a function of the square of the length of the ordinate between them.

It can be shown analytically that a hyperboloid generated in the manner described is the only solid of revolution that has the geometric characteristic referred to. The physical significance of this is that if the gas-channel of a Bunsen burner be constructed in the form of a hyperboloid the speed of any gas passing from the center toward either end under constant pressure will vary from point to point inversely as the square of the distance of the point considered from the center O.

I have found that a Bunsen burner thus constructed, with its relative dimensions proportioned as hereinafter set forth, produces a more perfect self-burning mixture of gas and air than the construction of gas-burner set forth in my aforesaid Letters Patent, and that this is due to the fact that the increase of speed of the entering gas mixture varies from point to point inversely as the square of the distance from the center O, and that the decrease of speed of the outgoing gas mixture varies from point to point inversely as the square of the distance of such point from the center O. I have also found that the best results are obtained when the angle between the asymptotes of the hyperbola which generates the hyperboloid is about sixteen degrees, that the efficiency over and above that

of my biconical Bunsen burner shown in my aforesaid patent decreases when this angle is varied, either increased or decreased, and that it vanishes almost entirely when this angle becomes twelve degrees and also when it becomes twenty degrees, so that in order to secure the advantage of my improvement the angle between the asymptotes must be somewhere between the limits of twelve and twenty degrees. Within these limits the gas mixture more nearly approaches that of a perfect self-burning gas mixture than in the case of my former Bunsen burner and attains more nearly perfection the nearer the angle between the asymptotes approaches sixteen degrees.

The length of the lower portion of the burner is determined experimentally in the manner set forth in my aforesaid patent, while the length of the upper portion may be varied without departing from my invention. I have, however, found that it is best to make the upper part of the hyperboloid four or five times as long as the diameter of its narrowest section.

The lower portion of the hyperboloid—that is to say, the part which extends from 2 2′ to O—is called the "mixing-space," while the upper portion, extending from O to 1 1′, is called the "suction-space," the lower portion being designed to cause such a proportional mixture of air and gas as will contain oxygen and hydrogen practically in the proportion of the chemical equivalents of these two gases, while the upper portion is designed to increase the draft of the gas mixture.

In accordance with the principles thus set forth the Bunsen-burner portion of my improved incandescent gas-burner is constructed as shown in Figs. 2 and 3. The hyperboloidal tube 1 1′ 2 2′ of the dimensions hereinbefore indicated, made of brass or other suitable metal, is formed with the air-ports 5 5 and has an external screw-thread at 1 1′ and an internal screw-thread below the air-ports, as indicated. A short tubular casting 6 is screwed into the lower end of the burner-tube and is capped, as shown, by a nipple 7, which in this case is indicated as screwed into the tubular section 6. It is, however, evident that the nipple may be formed in one piece with the casting. The nipple projects thus into the Bunsen tube, injecting the gas into the same and mixing with the air entering by the ports. The casting 6 is designed to be connected with the gas-supply pipe.

Onto the screw-threaded portion 1 1′ of the Bunsen burner is screwed a dished casting 8, upon which a hollow perforated cone-frustum 9 is fitted, and the two are united by another, but non-perforated, cone-frustum 10, which screws onto the dished casting and bears with a flange 11, formed near its lower end, upon the flange 12 at the lower end of the perforated cone-frustum. The upper opening of the perforated hollow cone-frustum is closed, preferably, by a metallic block 13, which may be biconical, as shown, and flat on its upper end and has there fitted to it a disk 14, serrated around its edge, as shown in Fig. 4, and secured to the block 13 by a screw 15. The disk and its serrations are of such size and all parts are of such height that the upper face of the disk is about flush with the upper edge of the hollow cone-frustum 10, but clearing the inner face of the same, so as to leave a narrow annular space between them. This annular space, which is best shown at 16 in Fig. 4, is thus bounded by the circular inner face or of the upper end of the cone-frustum 10 and by the serrated edge of the disk 14.

It will be seen from the foregoing description that the gas coming from the supply-pipe enters my burner at the casting 6 and discharges into the mixing-space of the hyperboloidal tube and there becomes mixed with the air entering by the ports 5. The two gases increase in speed toward the narrowest section of the tube in accordance with the law above set forth and arrive at the narrowest section with their maximum speed and in such proportion as to form a self-burning mixture. From that point the gas mixture continues with a speed that diminishes in accordance with the law above set forth and enters the hollow perforated cone-frustum 9, which, being closed at the upper end by the block 13, constitutes a mixing-chamber, from which the mixture issues by the perforations in its walls into the space bounded by that chamber and the external non-perforated hollow cone-frustum 10, and finally issues through the annular space between the disk 14 and cone-frustum 10.

Over the cone-frustum 10 is placed the mantle 17 of refractory material, the upper edge of which is fastened to a metallic ring 18, which in turn is hung from a bail 19, and the latter supported by a rod 20, which is secured to any appropriate portion of the burner. Other means than those here shown may be used for stiffening and holding in position the upper end of the mantle.

Within the mixing-chamber the gas mixture expands and then again becomes compressed at the perforations in the walls of the cone-frustum 9, then again expands within the space between the cone-frusta 9 and 10, and again becomes somewhat compressed at the annular space 16, where it is ignited. The alternate expansions and compressions of the gas mixture serve to more thoroughly mix the gases, as will be readily understood. The burning gas mixture, which is self-burning, impinges upon the mantle and raises the same to hyperincandescence.

I have found that by making the annular space 16, through which the gas mixture issues from the burner, alternately wider and narrower by the serrations in the edge of the disk 14 the flame with which the gas burns is very much more steady than if the annular space were uniform. The pulsating varia-

tions of intensity of light which would otherwise result are entirely avoided by this improvement.

I make the whole structure, with the exception, of course, of the mantle, of materials that are good conductors of heat, and therefore preferably of brass, bronze, or copper. The object and the effect of this are to conduct the heat from the serrated disk as quickly as possible, whereby the latter, which otherwise would be easily destroyed by the intense heat of the flame, is maintained at a comparatively low temperature and can be used for a long time without deterioration.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. A Bunsen burner having a gas-conduit shaped as a hyperboloid that is generated by a hyperbola rotating about its axis of ordinates, substantially as described.

2. A Bunsen burner having a gas-conduit shaped as a hyperboloid that is generated by a hyperbola rotating about its axis of ordinates and the asymptotes of which form an angle of more than twelve degrees and less than twenty degrees, substantially as described.

3. A Bunsen burner having a gas-conduit shaped as a hyperboloid that is generated by a hyperbola rotating about its axis of ordinates and the asymptotes of which form an angle of about sixteen degrees, substantially as described.

4. In an incandescent gas-burner, an annular gas-outlet formed by a disk having a toothed edge and a tube concentrically surrounding the same, the disk being supported by and in good heat-conducting relation to a heavy block, the said disk and block being made of a metal that is a good conductor of heat, for maintaining the disk at a moderate temperature, substantially as described.

5. An incandescent gas-burner having an annular gas-outlet formed by the circular upper edge of the burner and a toothed disk of smaller diameter located within the same, whereby a steady annular flame composed of a continuous succession of thicker and thinner segments is produced, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OTTMAR KERN.

Witnesses:
WILLIAM MOORE ROBINSON,
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