(No Model.) 2 Sheets—Sheet 1.

E. B. CUTTEN.

GAS BURNER.

No. 394,101. Patented Dec. 4, 1888.

Fig. 1.

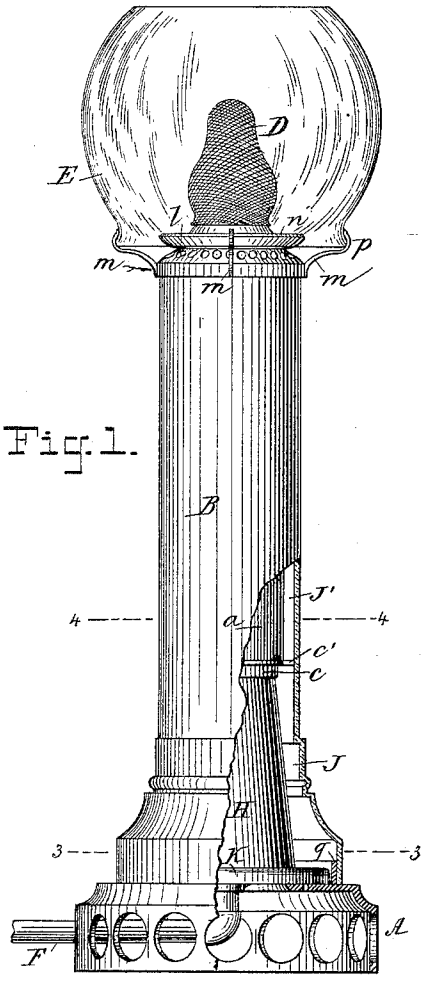


Fig. 2.

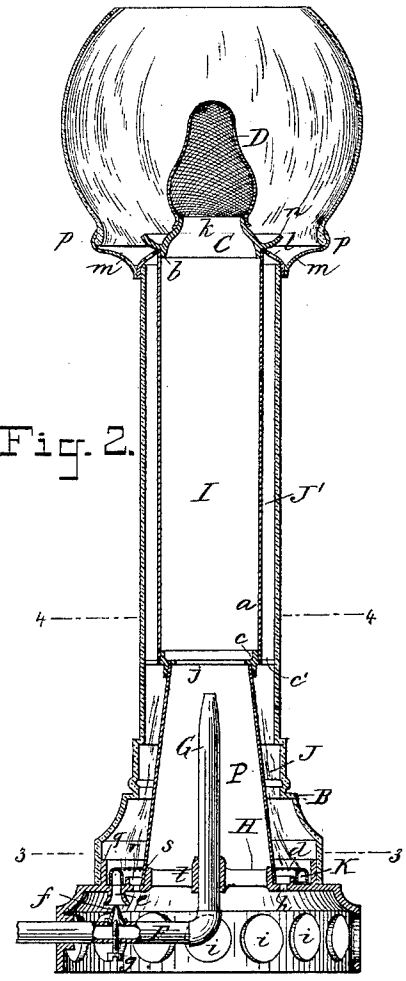


Fig. 3.

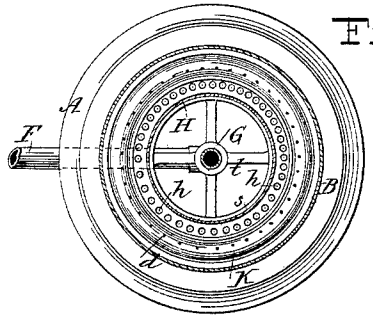
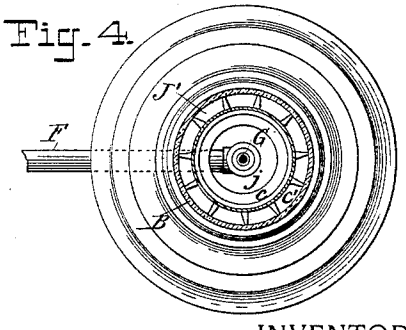


Fig. 4.



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By his Attorneys,

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(No Model.) 2 Sheets—Sheet 2.

E. B. CUTTEN.

GAS BURNER.

No. 394,101. Patented Dec. 4, 1888.

Fig. 6.

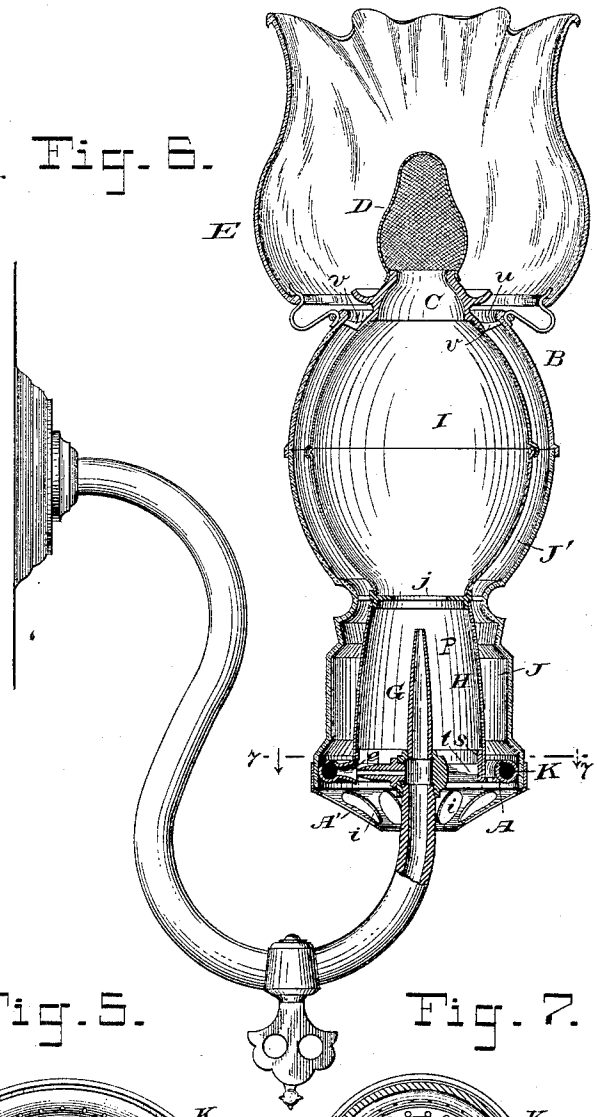


Fig. 5.

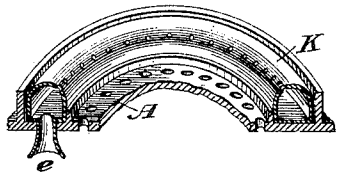
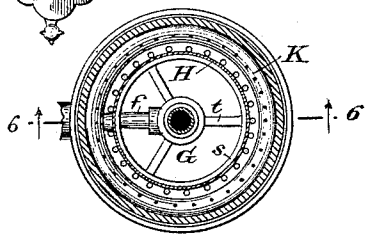


Fig. 7.



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UNITED STATES PATENT OFFICE.

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GAS-BURNER.

SPECIFICATION forming part of Letters Patent No. 394,101, dated December 4, 1888.

Application filed January 24, 1887. Renewed December 2, 1887. Serial No. 256,802. (No model.)

To all whom it may concern:

Be it known that I, ELISHA B. CUTTEN, a resident of Corry, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Burners, of which the following is a specification.

My invention relates to gas-burners on the Bunsen principle, or those wherein the gas is commingled with atmospheric air before being ignited. My improved burner is also on the regenerative principle, in that the air is heated before it reaches the flame.

The object of my invention is to produce either intense heat or intense light from the combustion of gas, and especially of natural gas.

One important aim of my invention is to produce what may be called a "blow-pipe flame" by the utilization of the pressure under which the gas enters the burner, thereby obviating the necessity of supplying the air under pressure.

It is well known that natural gas is supplied under a considerable pressure, and that it possesses but a slight illuminating property. My invention utilizes this pressure of the gas as a means of injecting air under sufficient pressure, and by directing the flame resulting from the combustion of the commingled and heated air and gas against a refractory incandescent body I produce a light of great intensity.

My improved burner or gas-lamp is constructed with a gas-jet tube or nozzle, by which the jet of entering gas is directed through an induction-passage, by means of which air is drawn in on the injector principle, and with a reverberatory or mixing chamber wherein the gas and air are thoroughly commingled before passing to the burner-tip. Small jets of flame are caused to play against the exterior walls of the air-induction passage, and the heated products of combustion therefrom pass up through an annular space or heating-chamber around the exterior of the mixing-chamber. Thus the entering air is heated before it reaches the gas, and subsequently the commingled gas and air are further heated before reaching the burner-tip. The burner-tip is of any suitable and sufficiently refractory material, and is contracted to a sufficient extent to hold the mingled gas and air beneath it under sufficient pressure to prevent the occurrence of explosions in the mixing-chamber. When the burner is to be used for heating purposes, the flame simply issues from the burner-tip; but when an illuminating-flame is desired a cage or basket of platinum wire or other suitable incandescing refractory material is placed over the burner-tip in such manner that the heat of the flame shall render it brilliantly incandescent. In such case, also, a glass shade should be placed around the flame in order to protect it from currents of air.

Figure 1 of the accompanying drawings is a side elevation of an illuminating-gas lamp constructed according to my invention and partly broken away to show the interior parts. Fig. 2 is a vertical mid-section of the same. Figs. 3 and 4 are horizontal sections in the planes of the lines 3 3 and 4 4, respectively, in Figs. 1 and 2; and Fig. 5 is an enlarged fragmentary detail view of the annular burner for heating the air. Fig. 6 is a vertical mid-section of a modified construction, and Fig. 7 is a horizontal section thereof cut in the plane of the line 7 7 therein.

I will first describe the lamp shown in Figs. 1 to 5. This is a standard lamp, or one which projects vertically from an extended base or foot, with the flame and its inclosing-globe at the top.

Let A designate the base or foot; B, the vertical standard or inclosing-case mounted thereon; C, the burner-tip; D, the incandescing cage or basket of refractory material, and E the glass globe or shade.

The base A is entered by a gas-pipe, F, which passes to the center thereof and then extends upwardly, terminating in a contracted tip or nozzle, G. On the base A is mounted a tube, H, preferably slightly conical in form, and which incloses the nozzle G. The space within this tube constitutes the induction-passage (lettered P) for the entering air. At its top is a contracted opening, *j*, into the mixing-chamber I. This chamber is formed by a tube, *a*, of metal or other sufficiently-refractory material, the upper end of which is confined by a flange, *b*, on the burner-tip, and the lower end of which is confined

by a flange on a small cast ring, *c*, as shown in Figs. 2 and 4. This ring *c* has also a downward flange for confining the upper end of the tube H and projecting arms or fingers *c'* for maintaining it centrally in position within the inclosing-case B. The space around the tube H and between it and the outer case, B, constitutes an annular combustion-chamber, J, and the space within the case B and around the chamber I constitutes an annular heating-chamber, J', which forms an upward continuation of the chamber J, having free communication therewith through the interstices in the ring *c* between the arms *c'*. In the bottom of the chamber J is an annular burner, K, shown detached in Fig. 5. This burner consists of an annular tube or passage, which is perforated with a row of jet-orifices, *d d*, on its upper inner side, and which receives mingled gas and air through an inlet-opening, *e*, beneath. The gas-pipe F has a jet-nozzle, *f*, directly beneath the opening *e*, through which flows a small jet of gas, which draws with it a current of air, and the mingled gas and air enter the burner K and emerge from the jet-orifices *d d* therein. The gas is here ignited, and the jets of flame impinge against the exterior of the tube H, thereby heating it to a high temperature. The intensity of the combustion of these jets is augmented by the admission of air through a series of perforations, *h h*, arranged just inside of the burner K. The jet of gas entering through the nozzle *f* is regulated by an adjusting-screw, *g*. The gas entering at considerable pressure by the nozzle G draws with it by induction a much greater volume of air through the induction-passage H. The air enters freely through openings *i i* in the base. In its passage through the tube H the air becomes highly heated by radiation therefrom and combines with the comparatively cool gas at the entrance to the reverberatory chamber I. In this chamber, which is of greater transverse area than the opening *j* into it, the gas and air circulate and become commingled and at the same time are further heated by radiation from the tube *a*, which is maintained at a high temperature by the hot products of combustion in the inclosing-chamber J'. The chamber I is sufficiently long to enable the gas and air in flowing through it to become thoroughly commingled and to be heated to the requisite high temperature. The commingled gases then flow through the contracted opening *k* of the burner-tip C and enter the interior of the refractory cage D. The combustion takes place in and around this cage, the flame being mainly confined therein, but extending partly outside of and above the same. The refractory cage or basket is rendered highly incandescent by the intense heat of the flame, and consequently emits a brilliant and steady white light of great illuminating-power.

The effect of the gas-jet from the nozzle entering under the requisite pressure and drawing with it the proper proportional quantity of air is to render the combustion very intense, the flame having the effect of a blow-pipe flame.

With natural gas at a pressure of four ounces and drawing in about ten times its volume of air I have produced a light of three-hundred-candle power. If the parts are properly proportioned, the combustion, although intense and although the flame appears to be under pressure, as from a blow-pipe, is unaccompanied by noise, irregularity, or other defect; but if the parts be improperly proportioned the flame will blow or hiss or be otherwise attended with objectionable irregularity. The contraction of the opening *k* in the burner-tip should be such as to confine the mingled gases beneath it at a pressure sufficient to prevent the liability of the flame burning downward into the chamber I, which, if it occurs, is attended with a slight explosion or with a series of slight explosions. If it is found that such explosions occur with any given proportion, they may usually be obviated by increasing the pressure of the gas, or with a given gas-pressure they may be obviated by substituting a burner-tip having a more contracted opening. The re-expansion of the gases as they pass through this opening necessitates that the refractory cage D shall be expanded just above the same, as clearly shown. If the cage is not thus expanded the brilliancy of the illumination will be greatly impaired. The cage should extend upwardly to nearly the height of the flame.

It will be observed that the jets of flame in the chamber J, playing against the tube H, heat the latter to a high degree, and thereby heat to a high temperature the entering air before it comes in contact with the gas, and that the gas is not heated to any degree until it emerges from the nozzle G and mixes with the heated air. This is important in the burning of natural gas, since the heating of the gas unmixed with air decomposes it. I therefore heat the air to a high degree before mixing it with the gas, and thereafter further heat the mixture and maintain the same at a high temperature until the combustion is effected.

The proper proportion of air is admitted to the gas in the chamber J to insure perfect combustion, and the jets from the burner K form elongated flames, which climb high up against the tube H, and may even extend into the chamber J'. The products of combustion from these flames ascend through the chamber J', giving up their heat meanwhile to the tube *a*, and emerge at the top through perforations *l l* in a metal cap or ring, *m*, which constitutes the retaining device for holding the upper ends of the tubes *a* and B in proper relative positions. The consumed gases issuing from these perforations should not be permitted to impinge upon the incandescent cage D, as thereby they would impair the combus-

tion therein and darken the incandescence. To prevent this, I form the burner-tip C with a flange or lip, *n*, projecting radially from it and preferably curved upwardly, as shown, in order to direct the consumed gases outwardly and away from the incandescent cage.

The glass shade or globe E is held by metallic fingers or brackets *p p*, attached to the metal cap *m*, or in any other suitable manner.

The outer tube or case, B, is molded of asbestus, in order to prevent radiation outwardly of the heat emanating from the flames from the burner K. The well-known refractory and non-conducting properties of asbestus enable me by its use to confine the heat of the regenerative flames and products of combustion almost entirely to the interior of the case B, thereby avoiding waste of heat and the inconvenient heating of the exterior of the standard. The asbestus case thus molded may be made of ornamental shape, such as that shown in Figs. 1 and 2, and may be variously decorated upon its exterior. I prefer to japan it exteriorly, applying any desired decoration known to the japanner's art.

I have shown the base A as made of cast metal, and combining in one casting not only the base or foot proper, but also an upright flange, *q*, for confining the bottom end of the asbestus tube B, a flange, *r*, for confining the burner K, a flange, *s*, for holding the lower end of the tube H, and a spider, *t*, consisting of radial arms and a central boss, for supporting the nozzle G. The series of air-holes *h h* is also formed in the base between the flanges *s* and *r*. The burner K is constructed of an annular trough stamped or spun from sheet metal and formed with the inclined perforations *d d*, and united to the base A between the flanges *q* and *r*. The inlet-opening *e*, with its funnel-mouth, may be cast in one piece with the base A, or may be made separate and screwed thereinto.

Although my improved burner is especially designed for natural gas, it is nevertheless equally adapted for use with other fuel-gases—such, for instance, as water-gas, and also for ordinary illuminating coal-gas. The burner may be adapted for greatly varying pressures, although the best effects are produced with pressures in excess of those ordinarily used for the distribution of illuminating-gas in cities. If the pressure of the gas be very low, it will be found advantageous to employ a forced current of air under more or less pressure, as thereby the brilliancy of the illumination and the intensity of the combustion may be augmented. This result will follow in any case from the use of a forced current of air; but it is very desirable to avoid the necessity for applying pressure to the air, as that involves the employment of special mechanism or of a distributing system of air-pipes.

In adapting the burner for different kinds of gas regard must be had for the proper proportion of air to be commingled therewith, and the proportions of the parts must be varied in accordance therewith, as well as in accordance with any change in the pressure of the gas. For example, while with natural gas about ten times the volume of air is required to insure perfect combustion, with illuminating coal-gas, on the contrary, only about five times the volume of air is required.

When my improved burner is to be used for heating purposes, the cage D is removed from the burner-tip and the shade E is dispensed with. One has then a blow-pipe flame of intense heat, which is admirably adapted for many metallurgical uses and other industrial purposes. With a burner of three-hundred-candle illuminating-power I have produced a heat sufficient for the welding of steel.

I am aware that in Bunsen and regenerative burners as heretofore made many constructions have been devised for heating the entering air and for commingling the air and gas.

I have aimed in the construction of my improved burner to subject the air and gas to the least possible internal resistance consistent with their proper mingling and preheating.

Fig. 6 illustrates a modification of my invention in the form of a bracket lamp or burner to be fixed to the wall. The construction does not differ in any essential respect from that first described. The principal difference is in the shape of the reverberatory chamber I, which is here made bulbous instead of cylindrical. The shortening of this chamber is undesirable when the gas is at considerable pressure, but is admissible when a comparatively low pressure is used. If the chamber be too short, the flame will burn with a hissing or roaring noise that is undesirable for most uses. The construction here shown is preferable whenever for any reason compactness is desirable, since by enlarging the chamber I laterally, it may be shortened nearly in proportion. I have shown the tube H as being less coned in this construction than in the preceding one, and with the opening *j* abruptly contracted, which in some respects is preferable. The cast base A here includes only the spider *t*, flange *s*, and burner K, the latter being cast as an annular tube with its opening *e* turned toward the center. The nozzle *f* projects laterally from the hub of the spider and injects gas into the opening *e*. The annular chambers J J′ are altered only in shape. The air enters at the bottom through openings *i i* in an ornamental piece, A′, which may be made of sheet metal. The consumed gases emerging from the chamber J′ at the top escape through an open annular space, *u*, the metal cap *m* in the former construction being omitted, and the burner-tip C being formed with fingers *v v* for holding the outer asbestus case, B, at the proper distance. This case B is necessarily made in sections in order to put it on over the chamber I.

My improved burner may with slight formal

or structural modifications be adapted to forges and to the heating of various things for diverse industrial uses. The expanding of the cage D immediately above the opening in the burner-tip is practically important, since if it be not so expanded explosions are liable to occur in the reverberatory chamber, which explosions are entirely obviated by expanding the cage at this point.

The cage D may be made of other materials than platinum—such, for instance, as magnesia; but the experience that I have had leads me to prefer platinum, in that it is more enduring. Instead of using a cage or basket inclosing the flame, any other refractory incandescent material may be employed, either in the form of a solid mass or more or less subdivided and arranged, so that it shall be exposed to the intense heat of the flame.

The burner-tip C is necessarily exposed to most intense heat, and therefore should be made of sufficient thickness and of a highly-refractory material, in order to enable it successfully to withstand this heat. I therefore make it of fire-clay or other highly-refractory substance. I prefer a material that will become incandescent upon being subjected to intense heat, in order that the burner-tip may, by its incandesence, contribute to the illumination afforded by the incandescent cage. This incandescence may be acquired by making the burner-tip of magnesia, which becomes luminous at a comparatively low temperature.

In practice, however, I prefer to make the tip of lime, which, ordinarily, will not be raised to a white heat, but which will prove more enduring than a magnesia tip.

What I claim, and desire to secure by Letters Patent, is the following-defined novel features and combinations, substantially as hereinbefore specified, namely:

1. In a gas-burner, the combination of a gas-inlet nozzle, an air-induction passage around the same, a contracted opening, a mixing-chamber beyond said opening above said nozzle, a contracted burner-tip, a heating-chamber around said induction-passage and mixing-chamber, an annular perforated burner at the bottom of said heating-chamber, a gas-inlet to said burner, and a series of perforations for admitting air to the bottom of said heating-chamber.

2. In a gas-burner, the combination of a gas-inlet nozzle, a mixing-chamber into which the jet from said nozzle enters, a contracted burner-tip, a heating-chamber around said reverberatory chamber, an annular perforated burner in said heating-chamber, an air-admission opening in said burner, and a gas-jet nozzle arranged to discharge into said opening.

3. In a gas-burner, the combination of a mixing-chamber, a gas-inlet nozzle directed toward the inlet to said chamber, a burner-tip at the outlet therefrom, an outer tubular case of asbestus arranged around said chamber and forming an annular heating-chamber between, and a gas-burner in said heating-chamber.

4. In a gas-burner, the combination, with a mixing-chamber, a gas-inlet nozzle, and a burner-tip, of an outer tubular case of molded asbestus arranged to inclose said chamber and to form an annular heating-chamber around it and a source of heat within said annular chamber.

5. In a gas-burner, the combination, with a mixing-chamber, a gas-inlet nozzle, and a burner-tip, of an outer tubular case of molded asbestus japanned upon its exterior, arranged to inclose said chamber and to form an annular heating-chamber around it and a source of heat within said annular chamber.

6. In a gas-burner, the combination of a vertically-extending gas-inlet nozzle, G, air-tube H, inclosing it, ring *c* above said nozzle and air-tube, tube *a*, forming chamber I above said ring, burner-tip C, and outer case, B, whereby a heating-chamber is formed surrounding the tube H and *a* and an independent source of heat in said chamber.

7. In a gas-burner, the combination of the gas-inlet nozzle G, air-tube H, tube *a*, forming mixing-chamber I, burner-tip C, outer case, B, base A, burner K, and perforated metal cap *m*.

8. In a gas-burner, the combination of a gas-inlet nozzle, a mixing-chamber, an inclosing-case forming a heating-chamber around said mixing-chamber, a jet-burner within said heating-chamber, a contracted burner-tip at the outlet from said mixing-chamber, and an outwardly-projecting flange above the outlet for the consumed gases from said heating-chamber adapted to deflect said gases away from the flame.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ELISHA B. CUTTEN.

Witnesses:
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PASCHAL J. FERRARA.