(No Model.)

J. B. MULLOY.

INJECTOR AND BURNER.

No. 329,844. Patented Nov. 3, 1885.

Fig. 1.

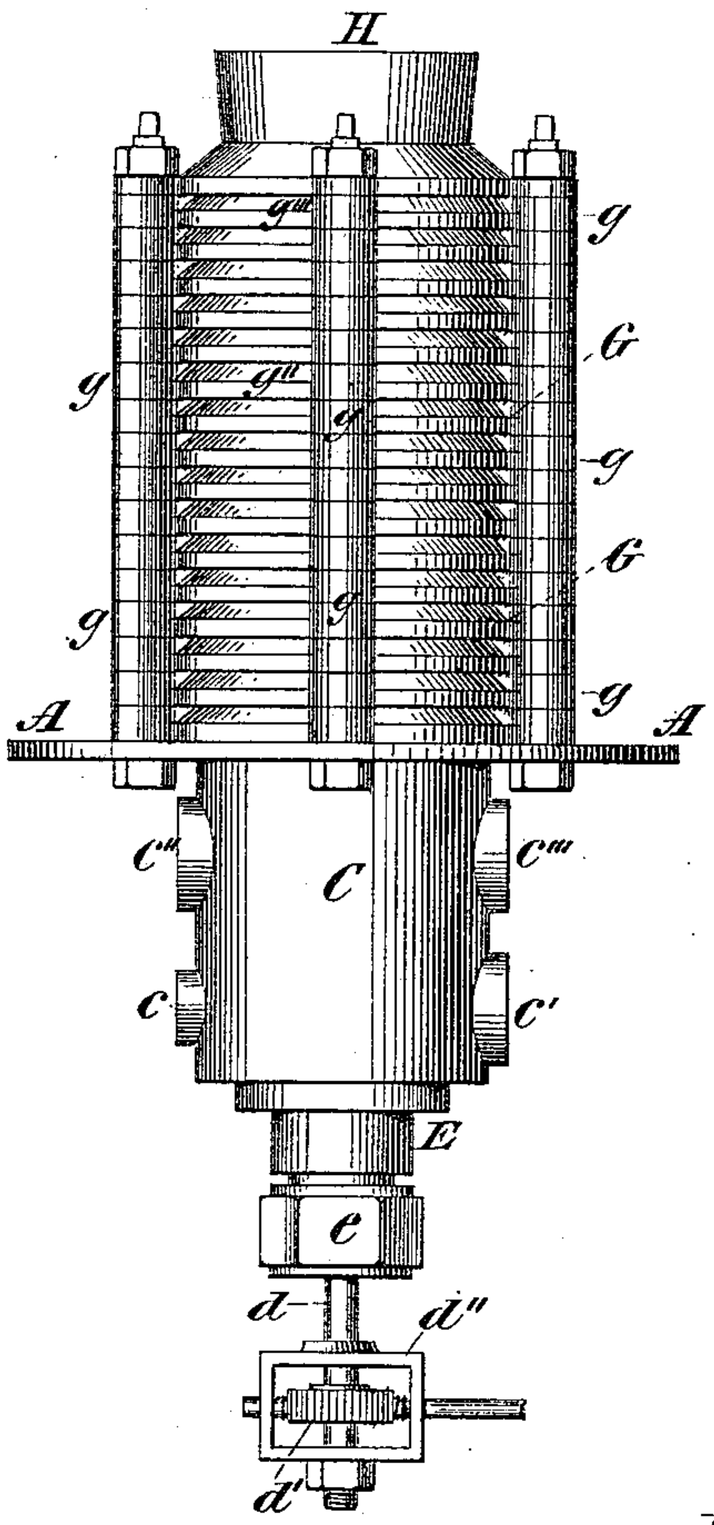


Fig. 2.

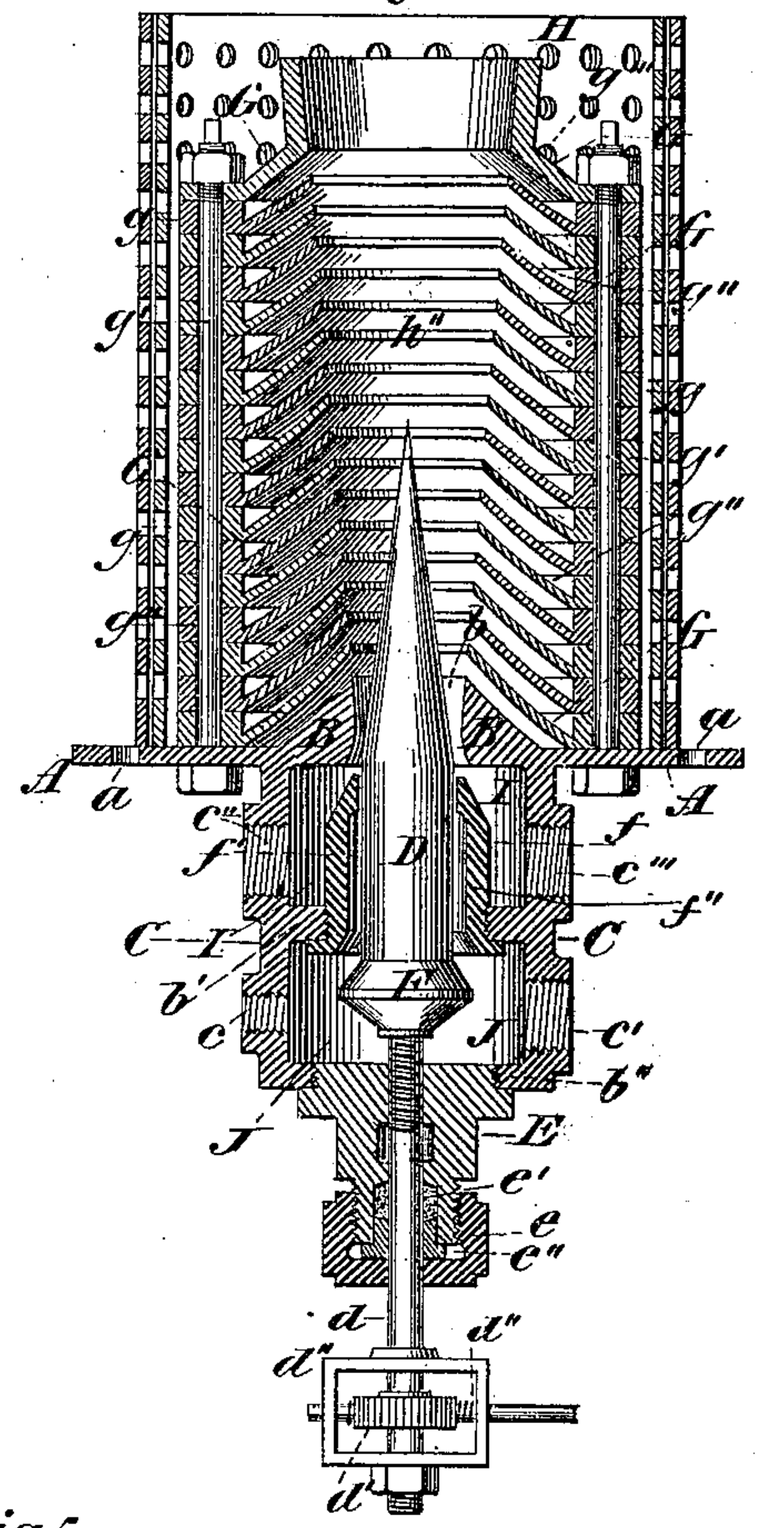


Fig. 3.

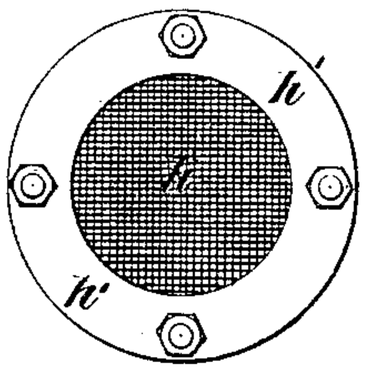


Fig. 5.

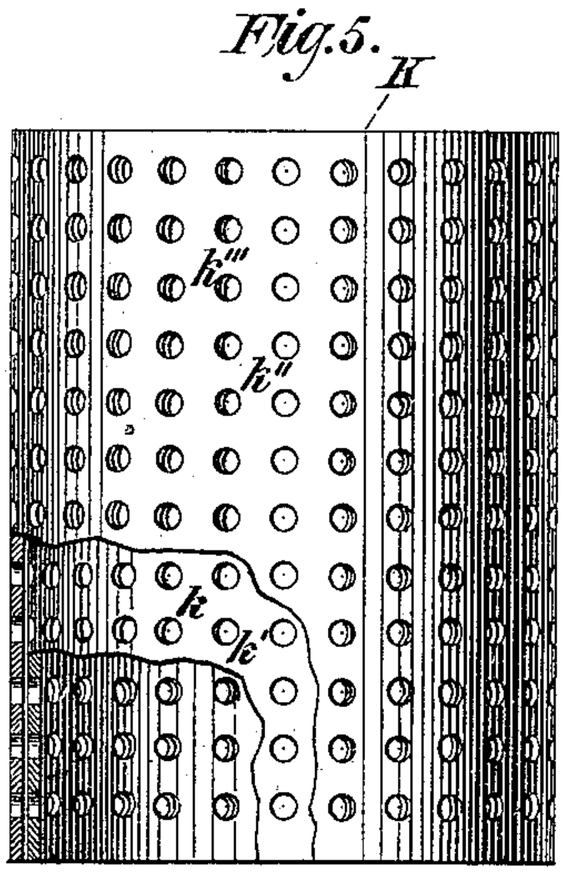
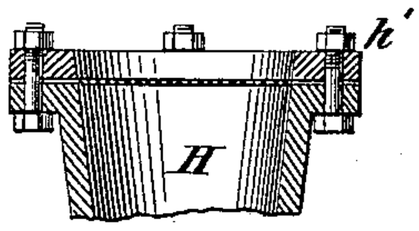


Fig. 4.



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JOHN B. MULLOY, OF LIMA, PERU.

INJECTOR AND BURNER.

SPECIFICATION forming part of Letters Patent No. 329,844, dated November 3, 1885.

Application filed November 24, 1884. Serial No. 148,761. (No model.)

To all whom it may concern:

Be it known that I, JOHN B. MULLOY, a citizen of the United States, residing at Lima, Peru, have invented a new and useful Improvement in Injectors and Burners, of which the following is a specification.

My invention relates to an improved injector and burner for gases or vaporized hydrocarbons; and it consists of an apparatus adapted to the production of intense heat, and to methods of applying said heat to practical purposes—such as the generation of steam, the smelting of ores, and to various other processes in which a high temperature is necessary. To obtain the best results I consider it necessary that the air and gas or gases should be thoroughly and intimately mixed before reaching the point of ignition. To this end I employ a base-plate having cast integrally therewith an inclosing shell or casing, said plate being provided with a suitable number of perforations for the reception of bolts, by which the injector and burner is attached to any desired apparatus. Cone-shaped disks are provided having perforated bosses or ears, by means of which the said disks are secured together and to the base-plate by confining bolts and nuts. Said cone-disks are arranged in series, and being centrally perforated are formed into the shape of a frustum of a cone, the diameters at said frustum gradually increasing in size from the lower cone, thus forming a central passage or mixing-chamber tapering from the upper to the lower cone-disk. The surfaces of the disks decrease in area from the lower cone. Midway upon the interior of the casing or inclosing-shell of the injector is formed an annular flange. Upon the lower end of said casing is formed an annular flange. Both of said flanges are provided with female threads. Formed upon the upper portion of the base-plate is a core or nozzle, bored or cast, with a flaring aperture constituting the "vena contracta" of an injector the spindle of which is operated by means of a rod provided with threads which mesh into threads cut on the casing-head. Said rod is operated by means of a worm-gear and pinion. At the base of the spindle is a valve which finds its seat upon a corresponding face on a tube encircling said spindle, the said tube being attached by a screw-threaded connection to the flange of the casing.

The burner is inclosed by a double-shelled hood, with means for regulating the admission of air.

Referring to the accompanying drawings, Figure 1 represents a side elevation of my improved injector and burner. Fig. 2 is a sectional view of the same. Figs. 3 and 4 are detail views. Fig. 5 is a side elevation showing the hood with a portion of the outer shell broken away.

A is a base-plate, provided with a suitable number of perforations, *a a*, for reception of bolts, which attach the injector and burner to any desired object or apparatus. Extending upwardly and formed centrally with relation to the base-plate A is a core or nozzle, B, within which is bored or cast a flaring opening, *b*. Extending downwardly from said base-plate is an annular hollow casing or shell, C, having screw-threaded apertures *c c' c'' c'''*, leading into the same. The interior of the casing or shell C has formed upon it an annular flange, *b'*, situated midway between the ends of said casing, and provided with threads for engagement by corresponding threads cut upon the exterior of a tube, *f*. The lower end of said casing has formed upon it an annular flange, *b''*, having a female thread. The lower portion of the aperture *b* flares outwardly, and constitutes the vena contracta of an injector, the spindle D of which is supported and operated by its screw-threaded rod *d*, having at its extreme lower end a pinion, *d'*, meshing into the worm *d''*, by which said rod *d* is operated. The rod *d* is provided with a male thread on that portion of its length which enters into and passes through a cap or head, E, provided with a female thread with which the male thread on the rod *d* meshes. A gland or packing-nut, *e*, screws onto the said cap or head E by a threaded connection, and serves to compress the packing *e'* and the washer *e''*, preserving a tight joint about the rod *d*. The base of the spindle D is provided with a valve, F, which, when the rod *d* is screwed down, finds its seat on a corresponding face formed on the tube *f*, which latter surrounds the spindle D, said tube *f* having a male thread which meshes into or with the female thread on the

flange b', thus securing the said tube f to the casing C. An annular passage, f', is formed between the tube f and the spindle D.

Upon the base-plate A are mounted centrally-perforated disks G G, having the shape of a frustum of a cone, said disks G G being provided with circumferential bosses or ears $g\ g$, which are perforated for the reception of confining-bolts $g'\ g'$, which secure the disks G G together and to the base-plate A. It will be seen that the bottom one of the cone-shaped disks rests flat upon the base-plate A, thereby preventing the admission of any air at the base of said disk. This is done in order that the air may be admitted gradually as the current ascends in the mixing-chamber h'', and prevent a great influx of air at the bottom cone, as is customary with devices as heretofore constructed. If it is desired to have the base of the bottom cone open, this same result—*i. e.*, the prevention of a great influx of air—would be accomplished by the nozzle B, which projects upwardly into the lower cone and occupies the same position relatively to said cone as it (the cone) occupies to the one next above it. By the use of both the flange A and the nozzle B a closed circulating space is formed, as shown in Fig. 2. The said disks G G are arranged in series, one above the other, and as the bosses or ears $g\ g$ are of a greater thickness than the disks air-spaces $g''\ g''$ are formed between them. The upper cone, g''', is provided with an upwardly-projecting rim, H, and upon this may be secured a gauze screen, h, and a clamping ring, h'. The opening in said upper cone, g''', may, however, be of any desired or necessary shape. The central perforations in the disks G G vary in size, gradually increasing from the lower one in the series to the upper, and providing a continuously-increasing central tapering mixing chamber or passage, h'', thus decreasing to the same extent the distance from the inner portion of each cone to its outer edge, providing a gradually-decreasing disk-surface from the lower to the upper disk. By this means the resistance to the induction of air through the spaces is decreased from the base to the mouth of the mixing-chamber, so that the volume of air supplied is gradually increased. The disks G G, having the central apertures, and the air-spaces $g''\ g''$, form the mixing-chamber h.

I is the upper chamber, and J the lower chamber, of the injector, which may be separated from each other by screwing the valve F, by means of the rod d, down upon its seat on the tube f, the said tube f, when the valve F is open, forming an extension of the chamber J.

The pipe through which steam is conducted may be connected at c to the lower chamber, J, and the pipe for gas may be connected to the opposite side of said chamber J at c'. The pipes for gas or vapor lead directly into the upper chamber, I, by being connected at c'' c''', respectively. The combining-chamber is surrounded by an annular double-shelled hood, K, Fig. 5, the inner shell, k, of which is provided with inlet-apertures k', and the outer shell, k'', with apertures k''', the air being admitted to the spaces $g''\ g''$ by turning the outer shell, k'', so that its apertures k''' will register with the apertures k'' in the inner shell. This shell or hood is shown in position, Fig. 2.

The operation of the described apparatus is as follows: I take from a reservoir any suitable gas under pressure to the lower chamber, J, the quantity which passes through the annular passage f' being regulated by the valve F, operated by the pinion d' and worm-gear d''. Said gas, in its passage through the aperture b, creates by its velocity a vacuum in the upper chamber, I, and mixes with the induced currents of air coming into the combining-chamber through the air-spaces $g''\ g''$. It is essential in most cases, in order to produce economical results, that this air should be preliminarily heated. It will be seen that the air and gas which passes through the combining-chamber is thoroughly mixed, since by the gradual increase in size of the tapering central passage the gas is to a certain extent checked as it issues from the aperture b, while at the same time the disks G G, gradually decreasing in area and sloping toward the central passage, do not prevent the air and gas from passing into the combustion-chamber or furnace. When it is desired to use steam, it is admitted into the lower chamber, J, through the opening c, the gas being shut off at c' and admitted from the reservoir at c'' into the upper chamber, I. The superheated steam is then allowed to pass through the annular passage f', and through the aperture b, where it mixes with the atmospheric air coming through the air-spaces $g''\ g''$. If, instead of gas, it is desired to use a vaporized liquid hydrocarbon, it can be conducted into the upper chamber, I, through the aperture c''. The pipe from the reservoir connecting at c'' being closed, the combustible gases will be drawn into the chamber I and forced by the annular jet of steam surrounding the spindle D and issuing from the annular passage f' into the combining-chamber and mixed with the atmospheric air, gradually admitted to the air-spaces by means of the damper in the hood K. The combined gas and air or steam and vaporized liquid hydrocarbon is, by the velocity of the steam and gas, carried up through and out of the combining-chamber, igniting as it passes the constant flame of a small jet of gas, which is brought through a small pipe to the opening of the burner. Thus no combustible gases pass into the furnace or combustion-chamber without having first been ignited. As the steam and hydrocarbon vapor or gas are injected into the combining-chamber of the burner, the atmospheric air, laden with oxygen, is drawn by induction into the current passing through the central passage, h'', at first over longer disk-surface and into a column of less diameter, and then over gradually-increasing surfaces

and into a like increasing column, so that as the combustible gases intermingle their attenuation is accordingly increased; and to preserve the admixture bulk for bulk more space is provided for their united passage to the point or locality of combustion, and simultaneously and necessarily the amount of air admitted is gradually increased as the column increases, so that the great desideratum of perfect combustion—the quantity of fuel oxygen brought into action, rather than the quantity of fuel burned—is secured, and so in supplying each and all the elements required by the apparatus as a whole, there is obtained first a subdivision of the atoms of each, in order that there may be a more perfect combination and admixture of the whole.

I am aware that injectors have been constructed of a series of overlapping conical tubes so arranged that the spaces between the adjacent tubes gradually decrease toward the mouth of the ejector, and also that they have been constructed of overlapping conical tubes gradually increasing in size toward the mouth; but such are not the equivalents of my invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with an injector, of a series of equidistant cone-shaped disks having central openings gradually increasing in size and a gradually-decreasing superficial area.

2. The combination, with an injector, of a mixing-chamber constructed of a series of equidistant cone-shaped disks having central openings gradually increasing in size and a gradually-decreasing superficial area, said chamber having direct communication from end to end with the external atmosphere, as and for the purposes set forth.

3. The combination, with an injector, of a series of equidistant cone-shaped disks having central openings and gradually-decreasing superficial area, as set forth.

4. The combination, with an injector, of a series of equidistant cone-shaped disks having central apertures, enlargements, or bosses, resting one upon another, and bolts for securing them together, substantially as set forth.

5. The combination, with an injector, of a mixing-chamber consisting of a series of superposed cone-shaped disks having central openings gradually increasing in size from said injector, and with superficial areas gradually decreasing in the same direction, as set forth.

6. The combination, with an injector, of a series of superposed cone-shaped disks of equal diameter placed at equal distances apart and having central openings gradually increasing in size from said injector, substantially as set forth.

7. The combination, with an injector, of a mixing-chamber consisting of a series of cone-shaped disks having central apertures, a base-flange, and bolts passed through perforations in said disks and base-flange, whereby the whole is secured together, as set forth.

8. The combination, with the injector, of the mixing-chamber, gradually decreasing in diameter from its mouth to the base, formed by a series of cone-shaped disks having central apertures gradually increasing in size, and having direct communication with said injector by a central aperture, and a conical spindle projecting through said aperture and into the mixing-chamber, so as to further reduce it at the base, substantially as set forth.

9. The combination, with the shell or casing, divided into two chambers, I J, of the bore *b*, and the tube *f*, opening from the chamber J and discharging in the chamber I, in proximity to the bore *b*, and a single conical spindle, D, for regulating the outlets *b* and *f* of the respective chambers, as set forth.

10. The combination, with the casing having the flange projecting thereinto at an intermediate point, and the bore or outlet at one end, of a tube supported at its base by said flange and terminating in proximity to said bore or outlet, and a spindle made conical at one end for regulating the flow through said bore and tube and having a valve for closing said tube entirely, substantially as set forth.

11. The combination, with the casing C, having the two chambers I J, and the bore *b*, of the tube *f*, arranged as described, and the spindle D, having the conical portion for regulating the flow through the said bore *b*, and the valve F, for regulating the flow through the tube *f*, substantially as set forth.

12. The combination, with an injector and a base-flange, of a series of conical disks, substantially as described, having the bosses *g*, and the bolts *g'*, passed through said bosses for holding said disks together and to the base-flange, substantially as set forth.

13. In combination with a hydrocarbon-burner, a hood consisting of two shells, each of said shells being provided with inlet-apertures and means whereby the said apertures may be made to admit and regulate air, substantially as shown and described.

14. The upper cone, *g'''*, provided with an upwardly-projecting rim, in combination with the screen *h* and clamping-ring *h'*, as set forth.

JOHN B. MULLOY.

Witnesses:
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G. W. MCNULTY.