

(No Model.)

2 Sheets—Sheet 1.

E. BAKER.

APPARATUS FOR BURNING HYDROCARBONS.

No. 325,376.

Patented Sept. 1, 1885.

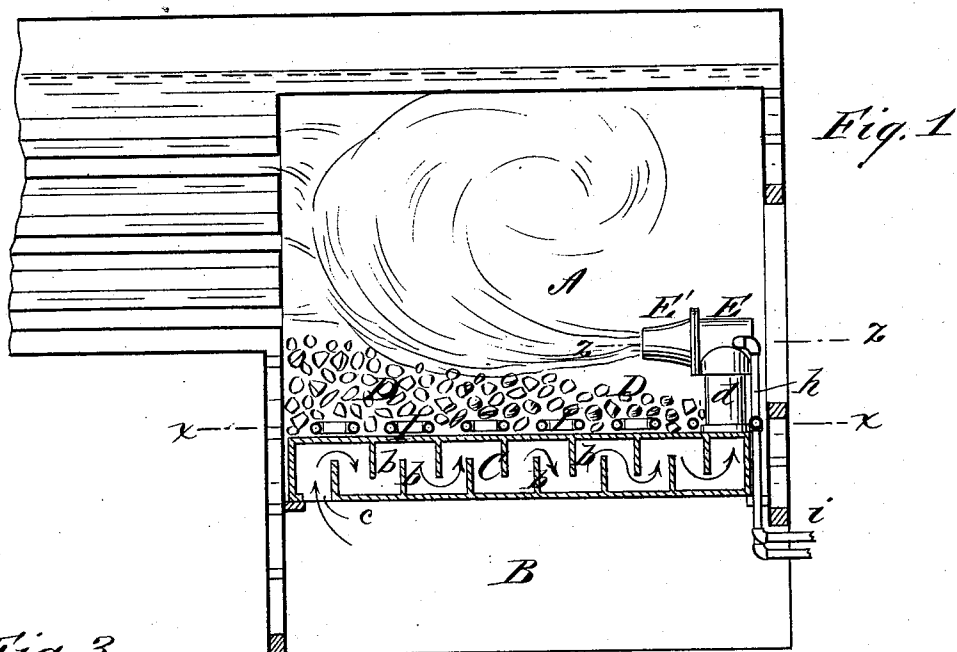


Fig. 3.

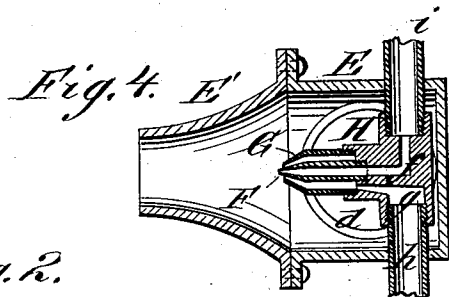
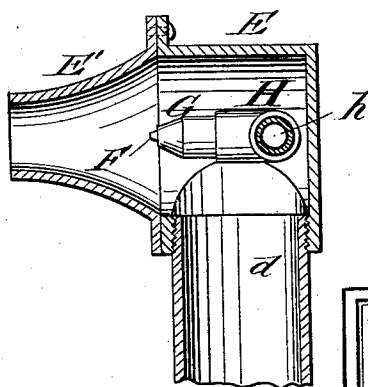
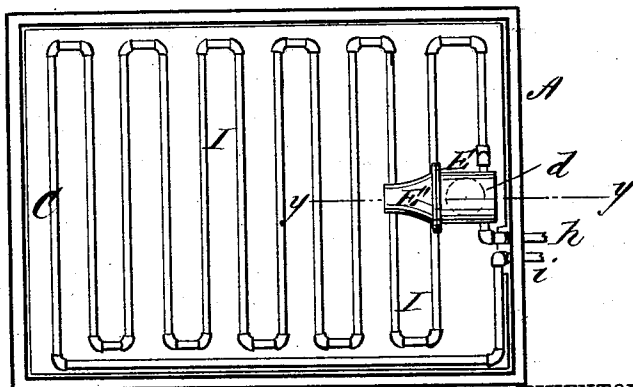


Fig. 2.



WITNESSES:

Donni Twitchell
to Sedgwick

INVENTOR:

E. Baker

BY

BY *Mum & Co*
ATTORNEYS.

(No Model.)

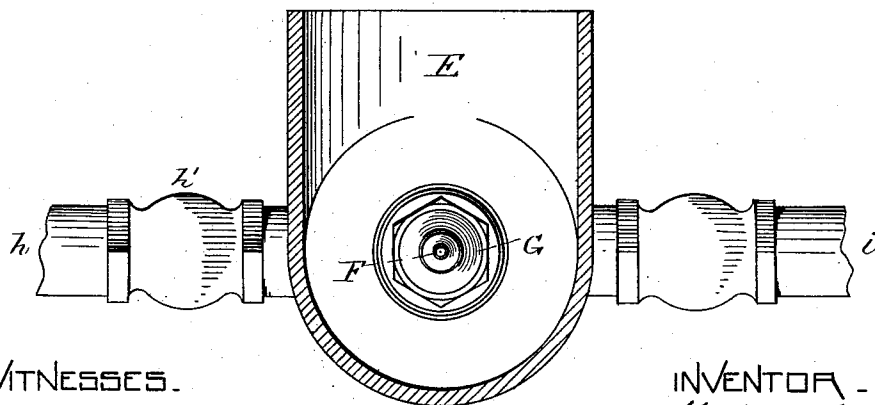
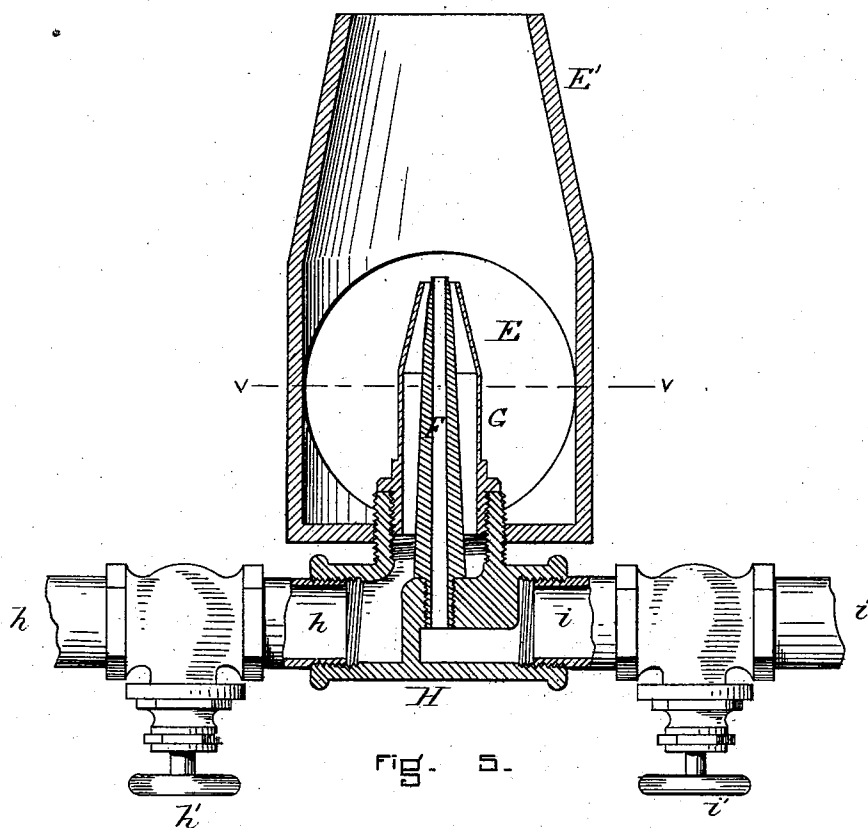
2 Sheets—Sheet 2.

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WITNESSES.

J. M. Dolan.
Fred. B. Dolan.

INVENTOR.

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UNITED STATES PATENT OFFICE.

ELBRIDGE BAKER, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE
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APPARATUS FOR BURNING HYDROCARBONS.

SPECIFICATION forming part of Letters Patent No. 325,376, dated September 1, 1885.

Application filed July 19, 1884. (No model.)

To all whom it may concern:

Be it known that I, ELBRIDGE BAKER, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and Improved Apparatus for Burning Hydrocarbons, of which the following is a full, clear, and exact description.

This invention relates more particularly to the burning of petroleum as a hydrocarbon fuel in furnaces of different kinds, including steam-boiler furnaces and furnaces for metallurgical and other purposes.

One of the objects of the invention is to obtain a more perfect volatilization and combustion of the vapor or gas obtained from the oil without exposing the oil to carbonize and clog the apparatus; and to this end the invention embraces a method, which it is my intention to make the subject of a separate application for Letters Patent, of volatilizing the oil and promoting the combustion of the gas by feeding the oil in a cool condition to the burner—that is, at a temperature below which the hydrocarbon will carbonize—and volatilizing and facilitating the combustion of the vapor by a blast of air, substantially as hereinafter described.

The invention consists in certain novel constructions and combinations of devices in the apparatus for burning such and other like hydrocarbon fuel, the same including a special construction of inspirator and burner, means for heating the forced blast of air by the furnace, and means for heating a natural supply of air to the inspirator for the purpose of effecting combustion. Both sets of these heating means may be dispensed with when cold air is used.

Most of the apparatus hitherto designed for burning petroleum has been apparatus which involved chemical decomposition and recombination of the hydrocarbons of petroleum-oils by the aid of superheated steam. On the doctrine of conservation of energy this chemical method necessarily involves some waste of the combustive value of the oil. All that is necessary for combustion of petroleum is the presence in the same place of a sufficient quantity of air, a sufficient quantity of liquid fuel, and a suitable temperature for the combination of the oxygen of the air with the hy-

drogen and carbon of the petroleum to insure combustion. If, therefore, the petroleum can be very finely subdivided mechanically, and, in the act of subdivision, furnished with a proper quantity of air to each subdivided particle for its combustion, and this can be done in a suitable combustion-chamber at a suitable temperature, the combustion will be complete.

The apparatus known as an “atomizer,” broadly considered, furnishes a suitable means for the minute subdivision, by the aid of air, of a liquid; but all atomizers do not do equally well with all liquids, and, therefore, for any given liquid it will be necessary to adopt a suitable form of atomizer, and work it in a suitable way; and in conducting an operation like that of combustion, or of supplying fuel and air to a flame in order to increase its intensity, it is of importance to determine the conditions requisite for air-supply, whether it should all be fed through the atomizing air-duct, or whether some portion, and, if so, what portion, should be fed by other means.

In mechanically atomizing petroleum by the aid of air for the purpose of feeding a flame it is important that crude and not refined petroleum be taken, because the cost of crude petroleum is moderate, and the cost of refined petroleum for an equal quantity of fuel is comparatively large. The common atomizer, consisting of two conical-ended tubes at right angles to each other, may be adjusted readily so as to serve a very good purpose as an atomizer of refined petroleum of a tolerably homogeneous quantity—such, for instance, as the illuminating oils or naphthas; but crude petroleum will not, on account of the very great difference in the gravity of its constituent hydrocarbons and their equally great difference in boiling and vaporizing points, be economically atomized with the cross-tube atomizer. I have therefore adopted for atomizing crude petroleum a form of atomizer consisting of a tube within a tube, the central tube being a conduit for compressed air, and the annulus between the central tube and the wall of the exterior tube a conduit for the oil. The location of the nozzle of the inner tube with regard to the nozzle of the tube surrounding it is of considerable importance. If the nozzle

of the inner tube terminate behind the end of the exterior tube, the oil will be thrown forward in drops rather than in spray, and will be imperfectly consumed. If it be allowed to project too far beyond the exterior tube, the oil will also be dropped and not sprayed. If it project from the interior tube too short a distance, the oil will be drawn out through the annulus faster than it ought to be. There is, therefore, a limited range allowable to the projection of the interior tube beyond the exterior tube.

In most, if not all, previous atomizing apparatus the interior tube which supplied steam terminated within the nozzle of the exterior tube through which the oil flowed. Instances of this are found in the English patent to Jones, No. 373 of 1873, and in Salisbury's patent, No. 205,143, June 18, 1878. Besides this, the width of the nozzle through which the oil flows at its termination is of considerable importance. If it be too narrow, a slot must be cut in the wall of the tube from the point back a considerable way, for the purpose of getting rid of gases that form near the nozzle; but if it be of proper width, the annulus need not be broken by such a slot.

I have found that the best width for the annular oil-nozzle at its mouth is about the diameter of the air duct through the center, but not less than about a twentieth of an inch, and this air duct may be as large as three-sixteenths of an inch, or as small as one thirty-second of an inch. The projection of the air duct beyond the end of the oil-nozzle should be somewhat greater with a large than with a small apparatus, and for good work may project from about a thirty-second of an inch to about a sixteenth of an inch. The quality of the oil affects this distance, but within the limits stated. Somewhere in the neighborhood of one-fifth or one-fourth of the air necessary to supply the flame should be forced through the central air-duct, and this should be done with a pressure of about from six to twelve pounds, the supply of air being furnished from a reservoir, into which it is forced by a compressing air-pump. This atomizer serves not only to mechanically subdivide the petroleum, but also to draw in and carry forward the remainder of the air necessary for complete combustion of the petroleum. For this purpose it must act like an injector or inspirator upon a body of air inclosed in or moving along a properly-formed channel, and the nozzle of the exterior air-duct must be some distance in advance, on the furnace side, of the end of the nozzle of the oil duct.

My experience leads me to believe that the shape of the end of the external air-conduit should be slightly conical, and that the delivery end should be of about four to eight times the diameter of the end of the oil-nozzle, and the end of the oil-nozzle should be located in the interior of this shell rather farther back from the end of its nozzle than the

diameter across the nozzle—say about the diameter of the untapered part of the shell. The oil is to be fed to this apparatus by gravity, and requires from three to six feet head. The induction oil-pipe and the induction-pipe for compressed air must each be controlled by a cock or valve to properly regulate the feed of compressed air and of oil. The rapidity of the feed of the compressed air will determine the rapidity of the feed of the inspired air, and either the compressed air or the inspired air may be heated before it enters the apparatus.

Reference is to be had to the accompanying drawings, forming part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 represents a vertical longitudinal section of a steam-boiler furnace or fire-box end of a boiler with an apparatus for burning hydrocarbon fuel embodying my invention applied. Fig. 2 is a horizontal section mainly on the line *xx* in Fig. 1; Fig. 3, a section through the inspirator mainly on the line *yy* in Fig. 2, and Fig. 4 a section through the inspirator on the line *zz* in Fig. 1. Fig. 5 is a longitudinal section of inspirator, air and oil nozzles, and their pipes; and Fig. 6 is a transverse section on the line *vv* of Fig. 5.

A indicates the fire box or furnace, and B the portion which corresponds to the ash-pit, but which in this case is merely an air-chamber and is surmounted by an air-circulating box, C, that takes the place of the grate in an ordinary fire-box, and is covered on its upper surface with broken brick D or other fragmentary material to receive the blast of the flame and to act as a retainer of heat. This box C is constructed to give a circuitous or prolonged travel to the air passing through it, for the purpose of more thoroughly heating the same, by means of reverse partial partitions *b b* or otherwise. The air which enters this box, as at *c*, has a natural draft, and is conducted by a pipe, *d*, to the outer chamber or case, E, and nozzle E' of the inspirator and burner, and serves to supply the necessary volume of air to effect the combustion of the gas supplied by the volatilization of the oil within said nozzle or nozzle-case. Said air, however, has its natural draft quickened or inspired by the action of a forced blast of air which is used to volatilize the oil, as herein-after described; and said air being heated within the box C or bed of the furnace effects more perfect and thorough combustion than if inspired cold.

In Figs. 3, 4, 5, and 6 the details of the oil and air supplying fixtures may be seen. In these *i* is the air-pipe, which is provided with a cock, *i'*, for controlling the supply of compressed air. *h* is the oil-pipe, which is provided with a cock, *h'*, for controlling the supply of oil. These two pipes enter opposite ends of a three-way coupling, H, across the center of which is a partition, much like the diaphragm in a globe valve, which separates

from each other the air-pipe and oil-pipe. Into this diaphragm is screwed the air-nozzle F, so that there is a continuous conduit from the air-pipe through the diaphragm into the air-nozzle F. The oil-nozzle G is fastened to this fixture H outside of the air-pipe, and this oil-nozzle is so formed that there is a considerable-sized chamber which terminates near the end of the air nozzle in the form of an annular frustum of a cone, the chamber of the oil-nozzle being considerably larger near its center and toward its base than at its delivery end. This combined oil and compressed air nozzle is inserted into the base of an air-inspirator, E, and lies along its axis. This air-inspirator is a casting open at the rear of the atomizing-nozzle F G, nearly three inches in diameter at its receiving end and about two and a half inches in diameter at the delivery end. The forward end of this inspirator is terminated by a hollow frustum of a cone, about a diameter long, and forming a nozzle, E', and the tip of the oil and air nozzle comes about abreast of the base of this frustum. The above measurements of the inspirator-shell E E' may vary considerably from this without materially affecting the efficiency of the apparatus.

The forced current of air supplied to the nozzle F, and which is furnished by an ordinary or any suitable pump, may be heated before it reaches said nozzle by causing it to pass through a circulating device above or on the bed of the furnace. This circulating device may consist of a coil of pipes, I, as shown, or it may be in the form of a box constructed with serpentine or circuitous ducts. In furnaces for metallurgical purposes I prefer the latter form.

By employing a forced current of heated air to volatilize the oil I dispense with heating the oil itself, which should be introduced cold. This prevents the oil from becoming carbonized and clogging the apparatus.

In the drawings the inspirator and burner is shown as arranged within the fire-box or furnace; but it may be arranged wholly outside, with its outer nozzle only entering or facing an aperture in the wall of the furnace; and instead of said inspirator and burner being arranged to occupy a horizontal position, as shown, it may be set oblique to the bed of the furnace or vertically in relation thereto, according to the description of furnace the invention is applied to. Furthermore, each furnace may have more than a single inspirator and burner, if desired.

The several pipes used to supply the air and oil should be fitted with regulating and shut-off cocks or valves.

In some cases the entire supply of air necessary to effect combustion of the gas or vapor might be furnished by the blast-nozzle F, through which the forced current of heated air is passed, thus dispensing with the outside nozzle or nozzle-case E E'; but as this would require a much larger amount of heated

air to be pumped or forced it is preferred to use the inspirator nozzle or nozzle-case E E' to supply, by natural draft or suction, a portion of the air. By arranging the inlet for the supply of air under ordinary pressure to the duct or nozzle E' in rear of the outlet end of the tubes or nozzles F G, the incoming air to the nozzle E' will have the effect of preventing the oil from lodging on the delivery end of the nozzle G and dripping therefrom.

I am aware that the Salisbury patent, No. 216,898, of June 24, 1879, shows an injector-burner which has an exterior oil-annulus, an interior steam-annulus the terminal of which is wholly within the oil-annulus, and a central air-tube, conveying atmospheric air, projecting beyond the end of the oil-annulus; and that the patent to Edwards, No. 251,849, of January 3, 1882, shows an injector-burner with an exterior steam-annulus, an interior oil-annulus, and a tubular valve-stem through which air not under pressure can flow; but my invention is not a steam-driven oil-injector, but an air-driven oil-atomizing injector. The central tube carrying the driving current of air is not the same thing as the central tube carrying a sucked or drawn current of air, but differs as a valve-rod does from a piston-rod in a steam-engine.

If the flame pulsates in using this apparatus when the atomizer is properly placed in the interior of the inspirator E E', considerable change in this position along the axis of the inspirator may be made without serious effect, and if the air-pressure is right and comparatively regular the pulsation will be due to one of two causes, either to the improper location of the end of the air-nozzle with relation to the end of the oil-nozzle or to the too great constriction of the oil-annulus. Adjustment of these according to the rules above laid down will remedy such a fluctuation.

A narrow slot cut in the upper side of the conical end of the oil-nozzle in the line of its axis, when the oil-nozzle is used in a horizontal position, will serve the same end as enlarging the annulus; but it is not a good practice when the atomizer is not used with its axis horizontal.

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

1. A hydrocarbon atomizer composed of two concentric nozzles, the interior one for air and the exterior one for oil, in which the air-nozzle projects slightly beyond the end of the oil-nozzle and is separated from it by an annular conduit about as wide as its own diameter, in combination with an apparatus for forcing through the central air-duct a current of compressed air, substantially as and for the purposes described.

2. In combination with an apparatus for forcing through the air-duct of the atomizer a current of compressed air, and a nozzle for compressed air surrounded by an annular

passage for oil and projecting slightly beyond the end of the oil-nozzle, an inspirator for a further supply of air arranged around the air and oil-nozzles and projecting beyond the end
5 of the air-nozzle toward the place of combustion, all substantially as and for the purposes described.

3. In furnaces or fire-boxes to be heated by liquid hydrocarbon fuel, the combination of
10 the air-circulating box C, forming the bed of the fire-chamber, with the inspirator nozzle or nozzle-case E E', and the atomizing tubes or nozzles F G, substantially as described.

4. In furnaces or fire-boxes to be heated by
15 liquid hydrocarbon fuel, the combination of the forced-air circulating and heating device I, within the fire-chamber, the air circulating and heating box or furnace-bed C, the inspi-

rator nozzle or nozzle-case E E', and the atomizing tubes or nozzles F G, essentially as and
20 for the purposes specified.

5. An apparatus for feeding hydrocarbon spray to a flame, which contains the combination of a central blow-pipe operated by air under pressure, an exterior oil-annulus
25 which presents a film of fluid to the atomizing influence of the blow-pipe, and an exterior cylinder conoidal inspirator-shell to furnish the larger part of the air needed for combustion of the hydrocarbon, substantially as
30 and for the purpose described.

ELBRIDGE BAKER.

Witnesses:

A. GREGORY,
C. SEDGWICK.