No. 836,529. PATENTED NOV. 20, 1906.

E. H. PEABODY.

FURNACE FOR BURNING LIQUID FUEL.

APPLICATION FILED AUG. 15, 1904.

Fig. 1.

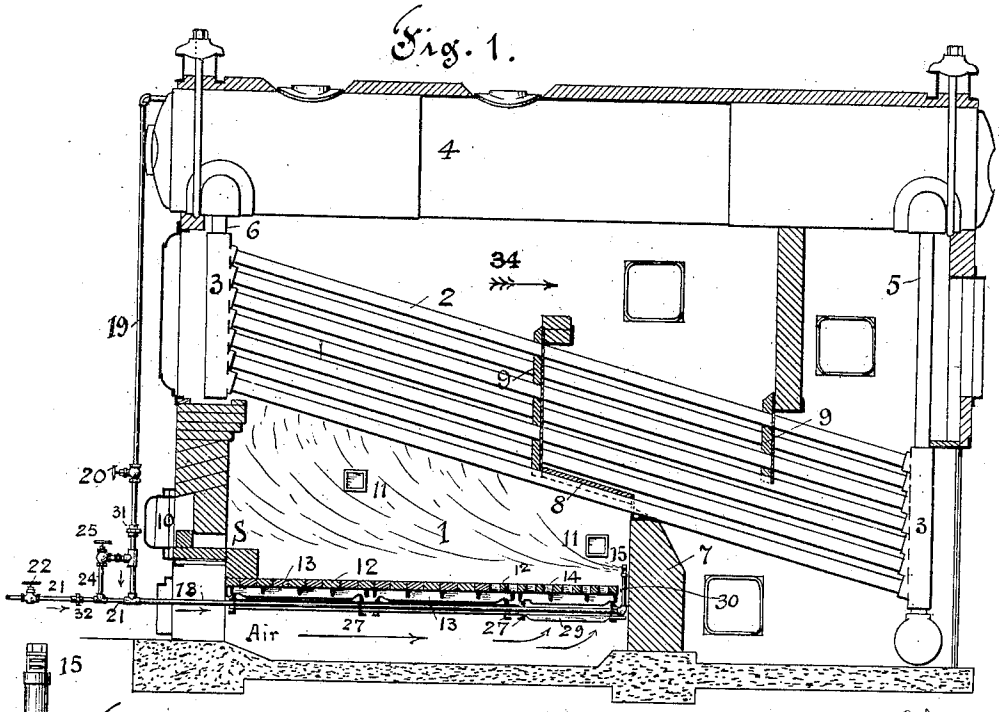


Fig. 4.

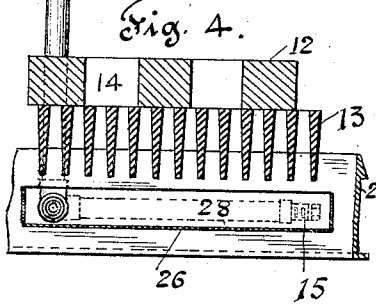


Fig. 3.

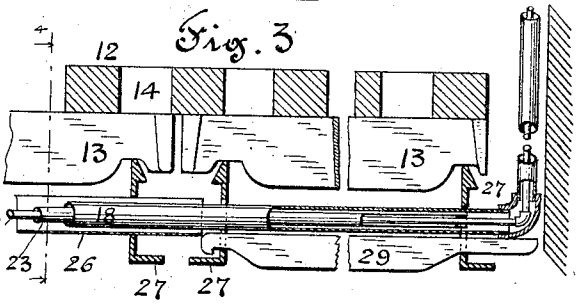
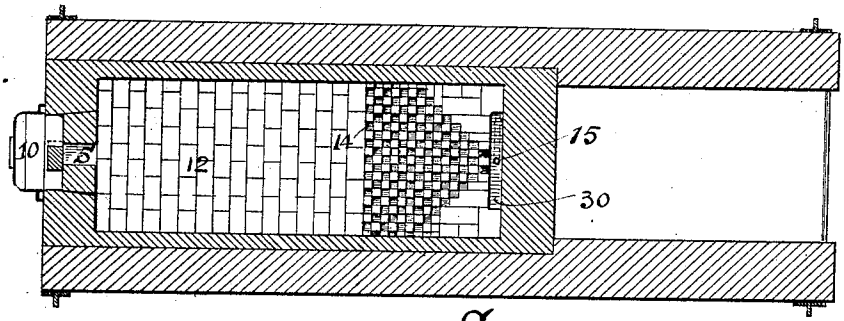


Fig. 2.



Witnesses
Charles Hanimann
Richard V. Roca

Ernest H. Peabody
Inventor

By his Attorneys Gifford & Pell

UNITED STATES PATENT OFFICE.

ERNEST H. PEABODY, OF NEW YORK, N. Y.

FURNACE FOR BURNING LIQUID FUEL.

No. 836,529. Specification of Letters Patent. Patented Nov. 20, 1906.

Application filed August 15, 1904. Serial No. 220,785.

To all whom it may concern:

Be it known that I, ERNEST H. PEABODY, a citizen of the United States, and a resident of New York city, borough of Manhattan, in the county and State of New York, have invented a new and useful Improvement in Furnaces for Burning Liquid Fuel, of which the following is a specification.

This invention relates to furnaces for burning atomized liquid fuel; and it consists in certain novel structures and devices especially adapted therefor which are pointed out in the claims concluding this specification.

The various methods of burning fuel may be divided into three distinct classes—first, that in which the fuel, whether solid or liquid, is stationary; second, that in which the fuel is introduced in the form of a gas or is so finely subdivided that it burns like a gas with flameless combustion, and, third, that in which the liquid fuel is introduced in the form of spray and burns with flame. My present invention relates to the last-named method. The practical art of burning such sprayed fuel differs radically from and involves problems not present in the art of burning stationary fuel (whether liquid or solid) or the art of burning gas or oil atomized to such a degree as to produce, like gas, flameless combustion. This difference is due to the fact, among other things, that when stationary fuel is used the fuel is widely distributed and at rest on the grate-bars, and the products of combustion are controlled by the furnace-draft alone and that when gas is used or flameless combustion otherwise produced questions of momentum and slow combustion do not enter into the problem. When, on the contrary, sprayed liquid fuel is used, the combustion is slow and the distribution of the products of combustion is controlled not by the furnace-draft alone, but also and mainly by the direction and momentum of the injected moving fuel and its great expansion when passing from the liquid to the gaseous condition. Furthermore, in the case of sprayed liquid fuel energy is necessarily consumed in subdividing it and injecting it into the furnace, and to diminish the energy thus consumed is a matter of prime importance. For those reasons, among others, furnaces which are well adapted, when using stationary or gaseous fuel to distribute the hot gases uniformly over and throughout the body of the water-tubes cannot be effectively used with sprayed liquid fuel burned with flame, particularly when operated at high capacities, for the reason that the heated gases concentrate on certain portions of the tubes, quickly burning them out and resulting in other losses. This difficulty I have sought to overcome by the use of certain forms of bridge-walls and baffle-plates; but these devices have proved inadequate. When, however, constructed as hereinafter described, the boiler may be highly forced without local overheating of the exposed tube-surfaces. No baffle or target wall is required. The flame is thoroughly distributed through the furnace, the gases expand and burn with substantial completeness before being cooled by the boiler-tubes below the temperature of ignition, and the amount of steam for atomizing the oil may be reduced to the minimum, thus giving greatly-improved net results in evaporation of water per pound of oil after deducting the percentage of steam used in atomizing.

Oils of the lighter varieties, such as the Texas, Ohio, and Pennsylvania oils, running in specific gravity from 22° Baumé up, can be gasified or atomized to the point of giving flameless combustion without the use of a very excessive amount of steam or other atomizing medium in the burners. Under these conditions the oil is easily handled, and the form of the furnace is comparatively of slight importance. On the contrary, heavy residuums and the heavy natural oils of California, running as low as 12° or 14° Baumé cannot be gasified or atomized fine enough to give flameless combustion without using so much of the gasifying or atomizing agent as to make this method of handling so expensive as to be prohibitive. Such oil is therefore when sprayed into the furnace burned with a considerable quantity of flame, and in order to obtain maximum efficiency and to insure high capacity without injury to the generator the form of the furnace and method of admitting the oil and distributing the resulting flame throughout the furnace is of vital importance. Moreover, if the furnace is constructed so as to economically and safely handle a large amount of flame the quantity of steam used for atomizing the oil can be reduced to a minimum, thus producing a direct saving in the cost of atomizing. It has been found, further, that a furnace which is adapted for handling heavy oils with considerable flame is also more economical in the use of light oils, which can also

be burned with flame, thus making it possible to save some of the steam used for atomizing.

In the drawings, which form a part of this specification, Figure 1 represents a side view of a steam-generator of the type referred to and shows the relative arrangements of the parts for using liquid fuel in its furnace-chamber in accordance with my invention. Fig. 2 is a plan view of the base or floor of the chamber, showing the relative position and means for admitting the constituents of the fuel to the chamber. Fig. 3 is an enlarged view, partly in section, of the specific details of construction of the base of the chamber and the connected fuel-feeding devices and supports. Fig. 4 is a transverse section of Fig. 3 on the line 4.

The following is a description of the structure shown in the accompanying drawings, which illustrate my invention, applied in the form at present preferred by me; but it will be understood that various modifications and changes may be made therein without departing from the spirit of my invention and without exceeding the scope of my claims.

The main parts of the steam-generator shown consist of the furnace-space 1, the group of inclined water-tubes 2, which are connected to headers 3, that communicate with the elevated steam and water drum 4 by means of the downflow-pipes 5 at the rear and the riser-pipes or nipples 6 at the front. A bridge-wall 7 is provided forming the rear end of the furnace-chamber. A roof 8 is provided, covering the smaller or lower end of the chamber and extending from the top of the bridge-wall 7, and baffles or partitions 9 are placed transversely of the group of tubes to direct the products of combustion to cross and recross the tubes to the uptake. The arrow 34 indicates the direction of the draft leaving the furnace-chamber opposed to the direction of the entering fuel. In the adaptation of my invention to this type of steam-generator the furnace-door opening 10 is partially closed and fitted with a peep-hole S to the chamber. Supplemental peep-holes are also shown at 11 in the side walls of the chamber.

The base or floor of the chamber is composed of a layer of fire-brick 12 or other suitable device, supported upon ordinary grate-bars 13, commonly used in boiler-furnaces. As shown in the plan view, Fig. 2, the floor or base is made practically air-tight for a greater portion of its area and is provided with a series of openings 14 at the rear or lower part of the chamber and directly under the fuel-burner 15. These openings are arranged to admit the air in a suitable location with relation to the escape of the liquid fuel from the burner 15, the number of openings being gradually increased in the line of the path of the oil projected from the burner.

The fuel-feeding apparatus with its connections and supports and regulating-valves and connected burner and the annular air-inclosing space and distributing-openings leading to the furnace-chamber are shown in Fig. 1 and in enlarged parts in Figs. 3 and 4. The liquid-fuel-delivery pipe 21 and the steam and air pipes 18 23 surrounding it are arranged beneath the floor of the furnace and suspended by the grate-bearers 27, as shown in Figs. 1 and 3. The steam-pipe 18 communicates with the steam-space of the steam-drum 4 by the pipe 19, which is provided with a stop-valve 20. The oil enters through the inner pipe 21, which is also provided with a regulating-cock 22 and which is incased within pipe 23, of larger diameter, which provides an air-jacket around the oil-pipe. Between the inlet-valves 20 and 22 a branch connection or by-pass 24 is provided, which is also provided with a stop-valve 25.

The liquid-fuel-delivery pipe 21, which, with the steam and air pipes 18 23 surrounding it, constitutes the shank of the burner 15, is arranged to pass from the front to the rear of the furnace below the floor through a sheet-iron trough or slideway 26, which is supported by the regular grate-bearers 27, the latter having appropriate openings 28 provided for this purpose, as shown in Fig. 4. The sheet-iron trough 26 extends only to the grating 29 toward the rear, as shown in Fig. 3, so that the upward flow of the air for combustion is not interrupted, while at the same time the burner is supported throughout its entire length and can be guided into position at the rear of the grating 29, where it is turned upward ninety degrees through the slot-like opening 30 in the brickwork, (shown in Fig. 2,) thus bringing the tip of the burner a few inches above the brick floor of the furnace in such a way as to blow the jet of mingled steam and oil in a reverse direction parallel to the shank of the burner. The valves 20 and 22 for controlling the steam and oil are located at the front of the furnace, at which point the operation of the burner is watched and controlled precisely the same as in the old-type settings. By disconnecting two unions 31 and 32, one on the oil and one on the steam pipe, the burner can be easily removed by withdrawing it through the sheet-iron slideway 26. The burner shown gives a broad flat flame, the steam and oil being injected through parallel horizontal slots located in the tip. In its passage through the shank of the burner the oil is prevented from being too highly heated by means of a pipe 23, which separates the oil-pipe 21 from the steam-space, thus providing an annular air-jacket around the oil-pipe. This fuel-feeding apparatus and the type of burner shown is not herein claimed. It, however, fills the special requirements of the form of furnace

and method of operation described and claimed.

In practicing the method herein described and claimed I wish it to be understood that said method is not intended to be limited in practice with the kind of combustion-chamber shown and referred to as the preferred form in the descriptive matter of the specification, as the method of operation claimed can be effected in other forms of chamber with the similar relative arrangement described of the exposed heating-surface with the path of the projected fuel and its dissemination by the effect of the furnace-draft, and whereby a forced combustion is permitted without injury to the heating-surface, which is an important feature of my invention.

It will be observed that the gases between their entrance among the tubes and their exit therefrom pursue passes among the tubes separated from each other by the deflectors 9 9. That portion of the furnace-chamber 1 lying vertically beneath the first pass corresponds in size and position with the fire-box of the ordinary coal-burning boiler of this type. That portion of the furnace-chamber which is not vertically beneath said first pass (formed by moving the bridge-wall 7 back from the position which it ordinarily occupies under the forward deflector 9) constitutes a rearward extension of said fire-box and forms a fuel-chamber from which the oil under steam-pressure is projected horizontally toward the front of the furnace, and the air-openings in the bottom of which fuel-chamber provide an upward draft of air beneath said projected fuel, which by the time the projected fuel has reached the fire-box proper or area beneath the pass into the tubes produces an upwardly-inclined flame equably distributed over the area of said pass. This construction enables the operator, looking in opposition to the projected fuel through the front peep-hole S and operating the steam and oil valves adjacent thereto, to so regulate the fuel-supply as to provide sufficient combustion for efficiency so equably distributed throughout the whole area of tubes exposed to the fire-box as to induce the proper water circulation and without undue burning of tubes.

Having thus fully described a structure involving my invention in the form at present preferred by me, what I claim, and desire to secure by Letters Patent, is—

1. In a water-tube-boiler furnace, means for atomizing oil and projecting it into the furnace in the form of spray and in a direction opposed to the draft leaving the furnace-chamber above the roof thereof combined with water-tubes in said roof.

2. In a water-tube-boiler furnace, means for atomizing oil and projecting it into the furnace in the form of spray and in a direction substantially horizontal and opposed to the draft leaving the furnace-chamber above the roof thereof combined with water-tubes in said roof.

3. In a water-tube-boiler furnace, means for atomizing oil and projecting it in the form of spray into a furnace-chamber of a size increasing in the direction of the entering fuel combined with water-tubes in the roof thereof.

4. In a water-tube-boiler furnace means for atomizing oil and projecting it in the form of spray into a furnace the roof of which is upwardly inclined in the direction of the entering fuel combined with water-tubes in the roof thereof.

5. In a water-tube-boiler furnace, means for atomizing oil and projecting it in the form of spray into a furnace of gradually-increasing size and in a direction opposed to the draft leaving the furnace-chamber above the roof thereof combined with water-tubes in said roof.

6. In a water-tube-boiler furnace means for atomizing oil and projecting it in the form of spray into the furnace in a direction opposed to the draft leaving the furnace-chamber above the roof thereof combined with water-tubes in said roof and a floor provided with draft-openings in the vicinity of the point where the atomized tool is introduced and dead surfaces beyond the draft-openings.

7. In a water-tube-boiler furnace means for atomizing oil and projecting it in the form of spray into a furnace of gradually-increasing size in a direction substantially horizontal and opposed to the draft leaving the furnace-chamber above the roof combined with water-tubes in said roof and a floor provided with draft-openings in the vicinity of the point where the atomized fuel is introduced and dead surfaces beyond the draft-openings.

8. In a water-tube-boiler furnace, means for atomizing oil and projecting it in the form of spray into the furnace in a direction opposed to the draft leaving furnace-chamber above the roof combined with water-tubes forming a part of said roof and a dead surface in the roof in the vicinity of the point where the atomized fuel is introduced.

9. In a water-tube-boiler furnace a combustion-chamber of gradually-increasing size having a roof in part composed of water-tubes and in part of dead surfaces combined with means for introducing sprayed liquid fuel within the covered part of the chambers in a direction opposed to the draft leaving said chamber.

10. In combination with a boiler-furnace, an atomizer provided with supply-pipes entering beneath the furnace-floor and extending from the front to the rear of the furnace under the furnace-floor substantially parallel with the path of the fuel discharged from the atomizer.

11. In combination with a boiler-furnace, an atomizer provided with supply-pipes ex-

tending from the front to the rear of the furnace under the furnace-floor and supported by the beams which support said floor.

12. In combination with a boiler-furnace, an atomizer provided with supply-pipes extending from the front to the rear of the furnace under the furnace-floor extending through perforations in the beams which support said floor and supported thereby.

13. In combination with a boiler-furnace, an atomizer provided with supply-pipes extending from the front to the rear of the furnace under the furnace-floor, a guideway supported by the beams which support said floor said supply-pipes resting on said guideway.

14. The combination with a steam-boiler of the horizontal inclined water-tube type having a fire-box which is unobstructed by arches or projections closed at its bottom and open to the water-tubes at its top, of a fuel-chamber forming a rearward extension of said fire-box, means whereby a hydrocarbon flame is projected horizontally from said fuel-chamber toward the front of said fire-box and means for establishing a draft of air into said fuel-chamber at substantially right angles to the course of the flame.

15. The combination with a steam-boiler of the horizontal inclined water-tube type having a plurality of passes for the gases through the tubes and a fire-box roofed by the tubes in the first pass, a fuel-chamber forming a rearward extension of said fire-box beneath the second pass means whereby a hydrocarbon flame is projected from said fuel-chamber horizontally toward the front of the fire-box and means for establishing a draft of air upward beneath said flame.

16. The combination with a steam-boiler of the horizontal water-tube type inclined upwardly toward the front having the entrance for the passage of the gases at the upper end of said tubes and a fire-box roofed by the tubes at said entrance, of a fuel-chamber constituting a rearward extension from said fire-box, means whereby a hydrocarbon flame is projected from said fuel-chamber toward the front of said fire-box and means for establishing a draft of air upward beneath said flame.

17. The combination with a steam-boiler having a fire-box which is unobstructed by arches or projections and closed at its bottom, of means for delivering a hyrdocarbon flame forwardly into the fire-box and means for establishing a draft of air into and at the same end of the fire-box and at substantially right angles to the course of the flame.

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

ERNEST H. PEABODY.

Witnesses:
S. CHAS. YEATON,
CHAS. J. RATHJEN.