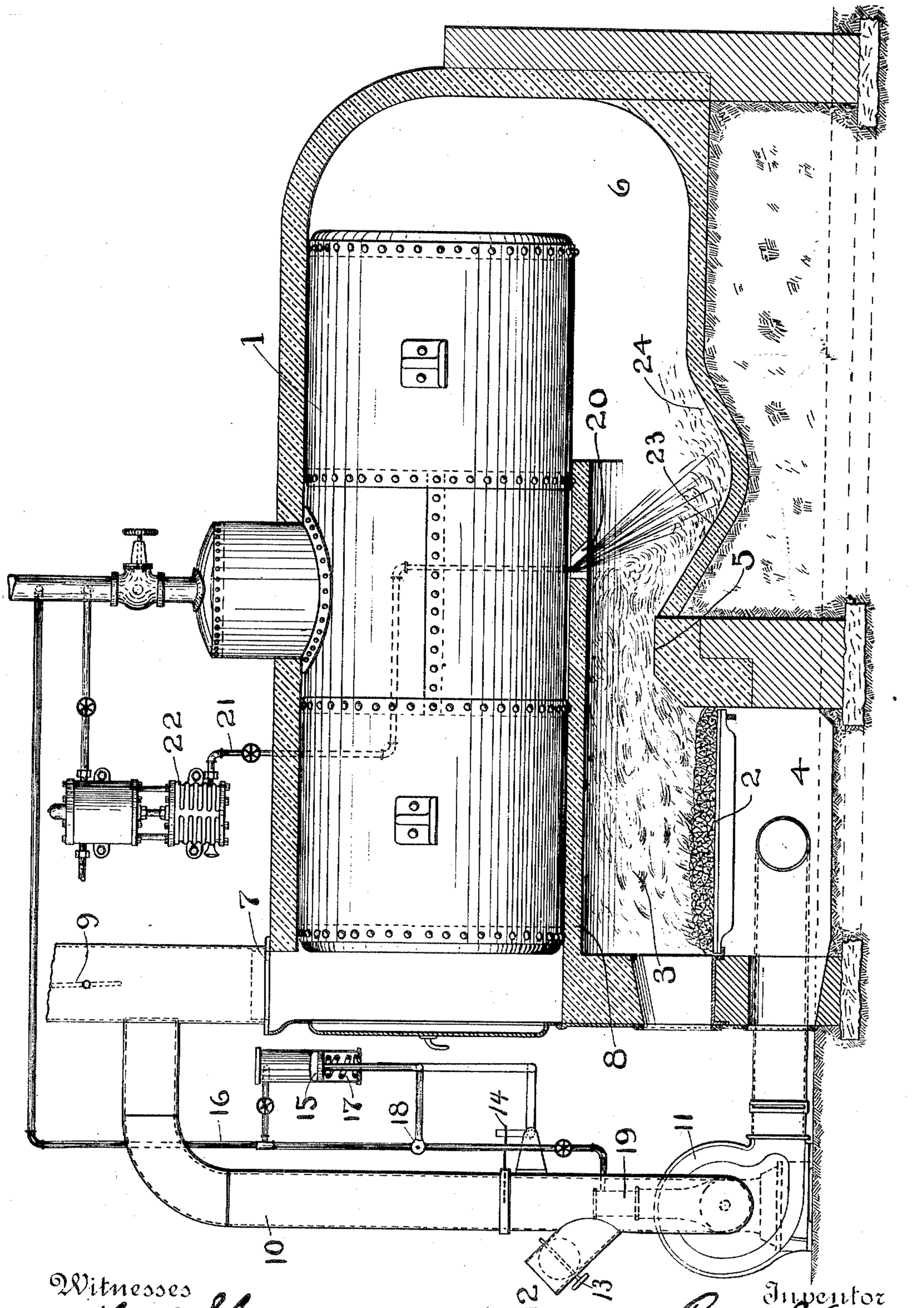
No. 811,626. PATENTED FEB. 6, 1906.

B. E. ELDRED.

STEAM BOILER FURNACE.

APPLICATION FILED NOV. 18, 1904.



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STEAM-BOILER FURNACE.

No. 811,626. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed November 18, 1904. Serial No. 233,241.

To all whom it may concern:

Be it known that I, BYRON E. ELDRED, a citizen of the United States, residing at Bronxville, county of Westchester, State of New York, have invented certain new and useful Improvements in Steam-Boiler Furnaces, of which the following specification and accompanying drawing illustrate one form of the invention which I now regard as the best out of the various forms in which the invention may be embodied.

This invention relates to steam-boiler furnaces; and its object is to apply the combustion process described in my United States Patent No. 692,257 to the generation and heating of steam. In that patent a long voluminous slow-burning comparatively cool flame is produced by passing through the fire a small portion of the waste products of combustion in company with a predetermined proportion of air. In a steam-boiler furnace it is found that special provisions are necessary to prevent the contact of this slow-burning flame to any great extent with the relatively cold boiler-surfaces, which would chill it and arrest its combustion. Consequently the ordinary boiler-furnace designed to produce a short flame is not suited to carry out the present invention. To avoid such contact until the continuance and eventual completion of combustion are insured, use is herein made of two expedients, one of which consists in the arrangement of refractory heat-retaining surfaces in such relation to the boiler as to keep the flame in its initial stages away from contact with the boiler, while the other consists in using for a like purpose a gaseous jet or jets, such as air-jets, so directed as to blow the flame away from the boiler. The jets have the further function of intensifying the combustion at a remote point. There is also employed a special arrangement of refractory reverberative surfaces heated by the flame and in such relation to the boiler as to radiate a large amount of heat thereto. The arrangement of the refractory surfaces and the arrangement of the air-jets in combination therewith are such as to subject the flame to a reasonably high temperature for quite a period after ignition, and thus prevent the formation of smoke from the premature chilling of the hydrocarbon gases of distillation. Thus is secured a practically complete combustion. The flame is carried out of substantial contact with the boiler-surfaces during the period of its incipiency, such a flame being considered incipient so long as its combustion is so incompletely advanced that contact with the cold boiler-surfaces would destroy or substantially arrest such combustion. A slow-burning and inflated flame is produced by passing a regulated amount of products of combustion, together with an air-draft, through the burning fuel on the seat of combustion, which may be a grate or any other form of burner for fuel. The products of combustion here, as in my patent hereinbefore acknowledged, have a double function. The contained carbon dioxid in part reacts with the fuel, entering into an endothermic reaction with the burning carbon, which it oxidizes to carbon monoxid with absorption of heat, itself also becoming converted into monoxid, and thereby produces a body of inflammable gas, and in part it acts like the nitrogen, generally forming most of the residue of the products of combustion to inflate and render slow-burning the gas so produced. The gaseous mixture and the air which passes through the fuel with it unchanged together form a long inflated flame. The endothermic reaction at the grate operates to protect metal parts and also to preclude the formation of clinker, while the heat so absorbed is again liberated when the gases are burned further on. The rate of combustion of this long flame is susceptible of perfect control, and it is intended to be so regulated that most of the combustion will take place as the mixture passes through a heated zone formed by a refractory walled fire-chamber and be completed by an auxiliary air-feed playing upon the flame and beating it down into a reversed reverberatory arch.

It has heretofore been proposed to bring back the whole body of stack-gases and pass them through the fire in an attempt to burn smoke and unconsumed gases; but this is obviously impossible, since the gases are greatly expanded by heat above the original volume of the air and fresh air must be continually added to maintain the heat of the fire. No substantial benefit could be had along these lines by burning up only a small part of the unconsumed products, and it does not appear to have been recognized that the premature cooling by the boiler-surfaces greatly in-

creases the proportion of unconsumed gases and defeats the very object sought. It would furthermore be dangerous to return combustible gases in company with air to the ash-pit. It has also been proposed to create a very intense combustion in a furnace separate from the boiler, using stack-gases returned through the grate and heating the boiler only with hot gases from a very hot fire; but gases are very poor communicators of heat, and it is highly inefficient to dispense with the radiation from an intensely-heated fuel-bed and from a hot flame. The present invention utilizes very largely the radiation upon the boiler from flame and from refractory surfaces. Contrary to the usual aim and practice of carrying an intensely-hot fuel-bed and burning all the gases in as short a distance therefrom as possible this invention proceeds upon the theory proven by experience with the process of the aforesaid patent that fuel, especially a bed of coal, can be more efficiently burned and used by keeping the fuel-bed comparatively cool and carrying the flame more fully into the region of the materials or object upon which it operates, special means being required when that object is a boiler to prevent premature chilling of the diluent inflated flame.

The accompanying drawing represents a vertical longitudinal section of a horizontal return tubular boiler provided with a furnace whose construction and operation embody the principles of the present invention.

1 is the boiler, beneath the forward end of which is a fire-box having grate 2, fire-chamber 3, and ash-pit 4, with the usual doors kept closed normally to secure a forced draft.

5 is the bridge-wall.

6 is the main chamber beneath and at the rear of the boiler, communicating with the rear ends of the boiler-flues, and 7 is the stack-connecting with the forward ends of said flues.

The roof of the fire-chamber is bricked over at 8 by an arch extending part way the length of the boiler. This arch might be extended further to the right than it is shown or not so far, depending upon the design of boiler and other conditions.

In the stack is a damper 9, and below this the inlet to a pipe 10, running to the ash-pit for returning a small portion of the products of combustion under the grate, these being drawn back by a fan-blower 11, whereby normally an artificially-accelerated draft is furnished to the fire. Air for supporting combustion is supplied through an inlet 12 to the pipe 10 back of the fan, and the relative proportions of air and stack-gases are controlled by valves 13 14 in the air branch and trunk of the pipe. I have also shown means for exercising automatic control of the amount of diluent going to the ash-pit by a piston 15, receiving through pipe 16 steam-pressure opposed to a spring 17, said piston controlling the valve 14 and also the throttle 18 of the engine 19, which drives the fan, the arrangement being such that increase of steam-pressure beyond a certain point calling for a cooler fire opens valve 14 to increase the relative amount of diluent and closes the throttle to slow down the fan and the draft which it furnishes.

At 20 is a nozzle in the arch 8 receiving compressed air through a pipe 21 from a compressor 22 and directing it in a jet across the path of the flame from the fire-box and against refractory reverberative surfaces 23 24. This air may be preheated by any suitable expedient.

In the operation of the apparatus a relatively small quantity of the total stack-gases is drawn back by the fan 11 and passed through the fire on grate 2, accompanied by a quantity of air definite in proportion and preferably sufficient to maintain a substantially complete combustion. From the fuel-bed emanates a voluminous slow-burning flame which at first is kept from contact with the boiler-surfaces by the arch 8, this flame being inflated by the neutral stack-gases, which retard the combination of the air and combustible. The heat-retaining character of the surrounding region insures the maintenance of ignition and an increasing temperature, and the jet from nozzle 20 agitates the gases and promotes their final combination within a restricted area, affording a culminating high temperature, which is assumed by the gases and by the reverberative surfaces at the bottom and rear of the chamber 6. An additional function of the jet is to keep the products of combustion away from contact with the boiler until combustion is substantially complete, the extent of this effect, as well as of the agitating effect, depending somewhat on the number and velocity of the jets. I thus succeed in maintaining a cool fire-box with obvious economy in fuel and repairs, reduction of clinker formation, less tendency to the formation of smoke or dust which arises from physical disintegration upon stoking a hot fire with fresh fuel, while at a later point I secure those temperature conditions which are conducive to a maximum evaporative effect. For this purpose the contents and reverberative surfaces of the chamber 6 lying near the entrance to the boiler-flues are most potent. In addition I have furnished the proper conditions for the prevention of smoke, as hereinbefore set forth.

The fire is automatically dampened through an increase in the steam-pressure by an increase in the relative quantity of stack-gases or by slowing the fan, or by both influences combined, and this without that chilling effect and loss of economy which result from a cold-air draft over the surface of the fire.

It is of course understood that various

modifications are permissible in the actual embodiment of the ideas herein set forth.

One of the advantages of my invention is that it enlarges the usefulness and decreases the expense of operating and repairing automatic stokers, particularly those employing underfeed and a forced air-draft; but as such appliances are familiar in the art it is unnecessary to here illustrate an example.

It may be added that my process cuts down the amount of excess air which it is customary to pass through the fire and for a part of this excess substitutes stack-gases or other suitable diluent. It will be evident that since a substantially constant quantity of these gases is continuously making the circuit the increase of volume due thereto does not represent wasted heat energy, as it does in the case of excess air going up the stack. It therefore becomes possible to operate with a strong forced draft whenever it is desired to increase the steaming capacity of the boiler, without any danger of burning out the metal surfaces or otherwise decreasing the life of the fire-box.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a furnace for burning fuel having a seat of combustion, means to pass through said seat a fixed gaseous diluent which will elongate and inflate the flame and retard its combustion, a steam-boiler within radiative reach of the flame, and means for carrying the elongated flame out of substantial contact with the boiler-surfaces during its incipiency.

2. The combination of a furnace having a refractory roofed combustion-chamber, means to produce a long slow-burning flame therein inflated with waste stack-gases passed through the seat of combustion, and a steam-boiler within radiative reach of the flame.

3. The combination of a furnace having a seat of combustion, a draft-chamber anterior thereto and supplying draft through the seat of combustion, and a waste-gas outlet, a return-conduit connecting said outlet with said draft-chamber and having a mechanical draft-accelerator, means to supply air to said draft-chamber, a steam-boiler located over said seat of combustion and heated by the furnace flame and gases, and a refractory wall roofing the furnace between said seat and the boiler for separating the flame from the boiler.

4. The combination of a furnace having a seat of combustion, means to pass products of combustion through the fuel-seat to elongate the flame, a steam-boiler within reach of the elongated flame, one or more jet-outlets in the roof of the combustion-chamber so directed as to blow the flame away from the boiler-surfaces at a point remote from the fuel-seat, and means to force a gaseous pressure fluid through said jet-outlets.

5. The combination of a furnace having a grate, a combustion-chamber and an ash-pit, means to supply an artificially-accelerated draft-current of air and stack-gases to said ash-pit, a refractory wall roofing said combustion-chamber, a steam-boiler, one or more jet-outlets located in the upper part of the combustion-chamber between the grate and the heating-surfaces of the boiler and so directed as to carry the flame away from the boiler, and means to supply air to said jet-outlets.

6. The combination of a furnace having a seat of combustion, means to supply to said seat a forced-draft current of air and diluent products of combustion to elongate and inflate the flame, a boiler, and a flame-channel included in the furnace and having a refractory surface in heat-radiating relation to the boiler and provisions whereby the flame is carried away from the boiler into contact with said surface.

7. The combination of a furnace having a seat of combustion, means to supply to said seat a forced-draft current of air and diluent products of combustion to elongate and inflate the flame, a boiler, and a flame-channel included in the furnace and having a refractory surface in heat-radiating relation to the boiler and one or more air-jet outlets on the boiler side of said channel directed toward said surface.

8. The combination of a steam-boiler, a furnace having a seat of combustion and a flame-channel roofed with refractory material between said fuel-seat and the heating-surfaces of the boiler, means to supply products of combustion and air through said fuel-seat to produce an elongated slow-burning flame, and means to locally agitate the flame substantially at the beginning of said heating-surfaces.

9. In a steam-boiler furnace the combination of a boiler, a fire-box therefor, means to supply air and a neutral diluent to the fire in such manner as to elongate the flame, means to substantially complete the combustion of the elongated flame at a definite or predetermined point remote from the fire-box and in radiative relation to the boiler, and means to maintain the flame in a surrounding reverberative influence anterior to said point and out of substantial contact with the boiler.

10. In a steam-boiler furnace the combination of a boiler, a fire-box therefor having a seat of combustion, means to supply air and products of combustion through said seat, a refractory roofed chamber between the fire-box and the flues of the boiler, and means to supply an intercepting jet of air to the flame issuing from said chamber.

11. The combination of a boiler, a furnace having a seat of combustion, means to supply air and products of combustion through said fuel-seat, a refractory roofed flame-channel

between said seat and the heating-surfaces of the boiler, and refractory surfaces heated by the flame and located beyond said channel in heat-radiating relation to the boiler.

12. In a steam-boiler furnace, a boiler, a seat of combustion, means to produce a long voluminous, slow-burning flame by inflation with waste stack-gases passed through the burning fuel and means to keep the long flame from contact with the relatively cold boiler-surfaces while combustion is incomplete, combined with refractory reverberative surfaces in radiating relation with the vaporizing-chamber of the boiler, heated by the flame and serving to maintain its ignition.

13. The combination of a horizontal return tubular boiler having a gas outlet or flue at its forward end, a fire-box under the forward part of the boiler having a seat of combustion, flame and gas passages extending rearwardly from the fire-box and forwardly through the boiler to the gas-outlet, a refractory wall roofing the fire-box between it and the forward part of the boiler, and means to pass products of combustion and air in predetermined proportion through said seat to elongate the flame.

14. The combination in a boiler-furnace of a support for burning solid fuel, means for supplying and passing through said support a neutral gaseous diluent in such manner as to inflate the flame and cool the fuel-bed, a boiler within heat-radiating reach of the flame, and means to keep the flame from contact with the boiler during its incipiency.

15. In a steam-boiler furnace the combination of a boiler, a fire-box therefor having a seat of combustion, means to pass through said seat a draft-current of air and neutral stack-gases, and means controlled by the steam-pressure for automatically varying the composition of the draft-current.

16. In a steam-boiler furnace the combination with the furnace of means for supplying air and for supplying stack-gases in the draft furnished to the fire, and means controlled by the steam-pressure for concurrently varying the volume and composition of the draft-current.

17. In a steam-boiler furnace, the combination of a boiler, a refractory walled fire-chamber, an inverted reverberatory arch beneath the boiler, means for producing an inflated slow-burning flame in the fire-chamber, air-introducing means for beating said flame down into the arch and completing its combustion, and means for carrying the resultant flame products into heat-radiating relation with the boiler.

In witness whereof I have hereunto set my hand this 25th day of October, A. D. 1904.

BYRON E. ELDRED.

Witnesses:
R. M. PIERSON,
A. M. SENIOR.