(No Model.) 2 Sheets—Sheet 1.

V. W. BLANCHARD.

Hydrocarbon Furnace.

No. 239,706. **Patented April 5, 1881.**

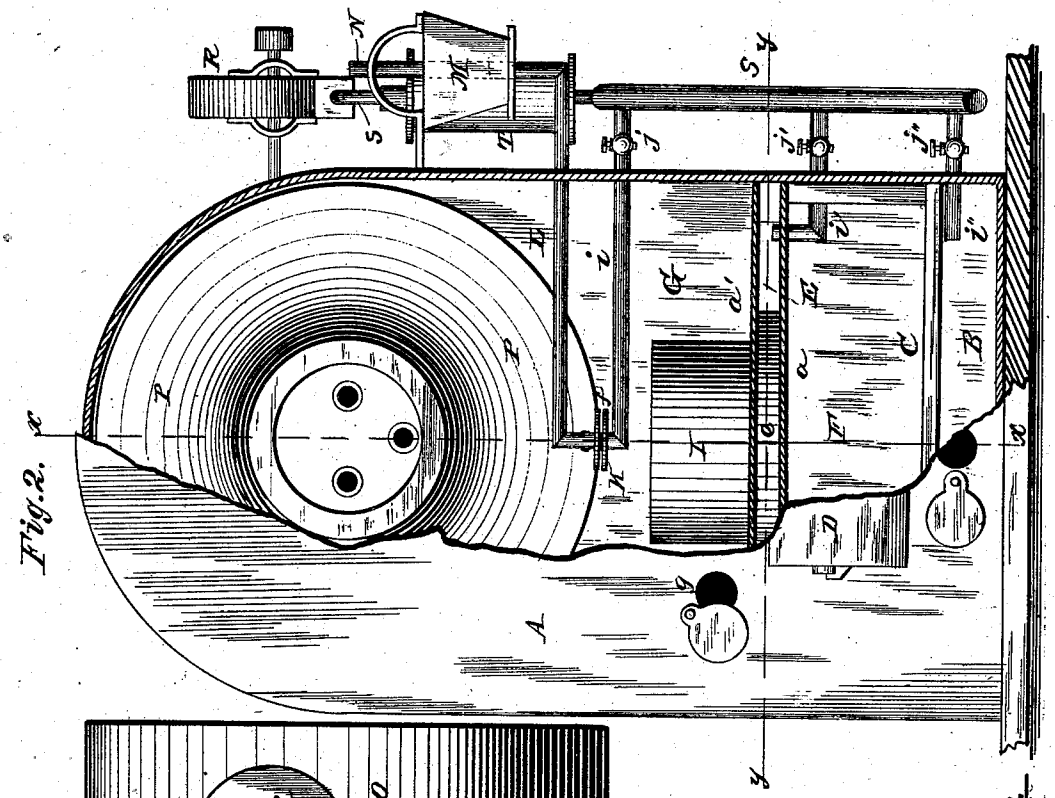

Fig. 2.

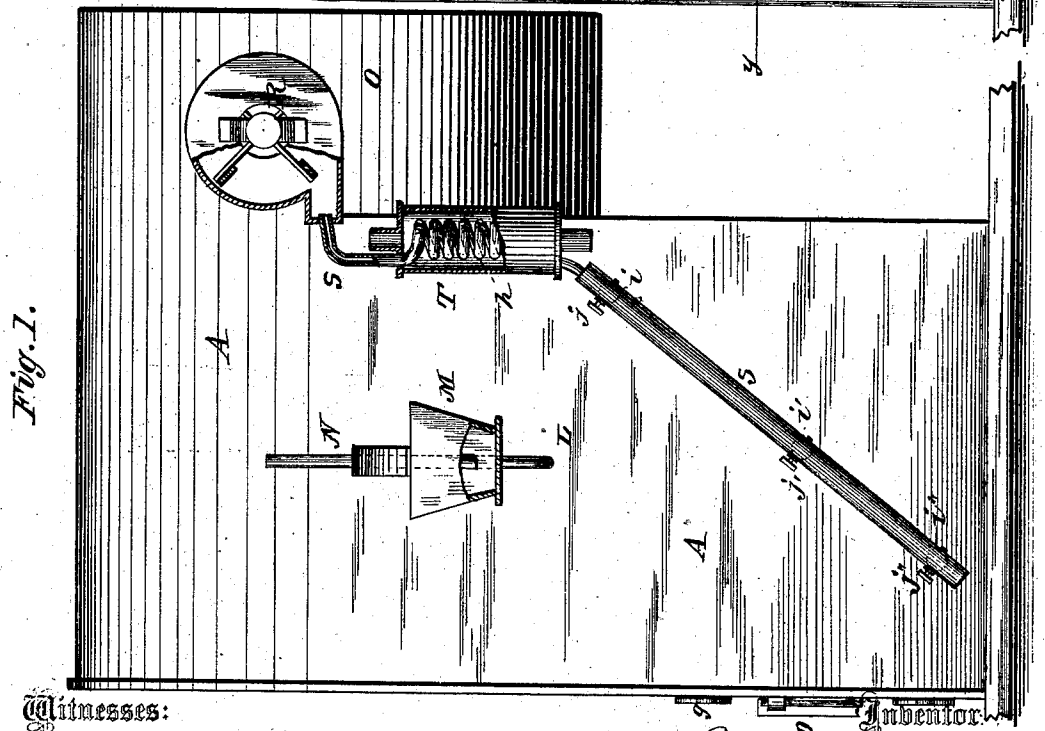

Fig. 1.

Witnesses:

C. Dietrich,

Wm. Kippenman.

Inventor.

Virgil W. Blanchard

Per C. A. Watson & Co., Attorneys.

(No Model.) 2 Sheets—Sheet 2.

V. W. BLANCHARD.

Hydrocarbon Furnace.

No. 239,706. **Patented April 5, 1881.**

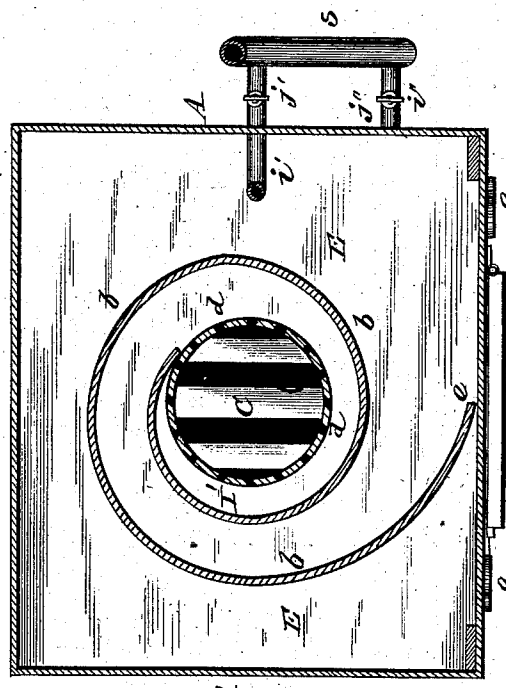

Fig. 5.

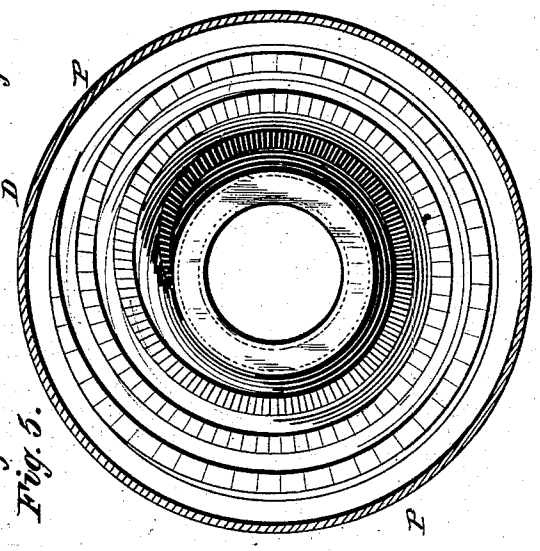

Fig. 4.

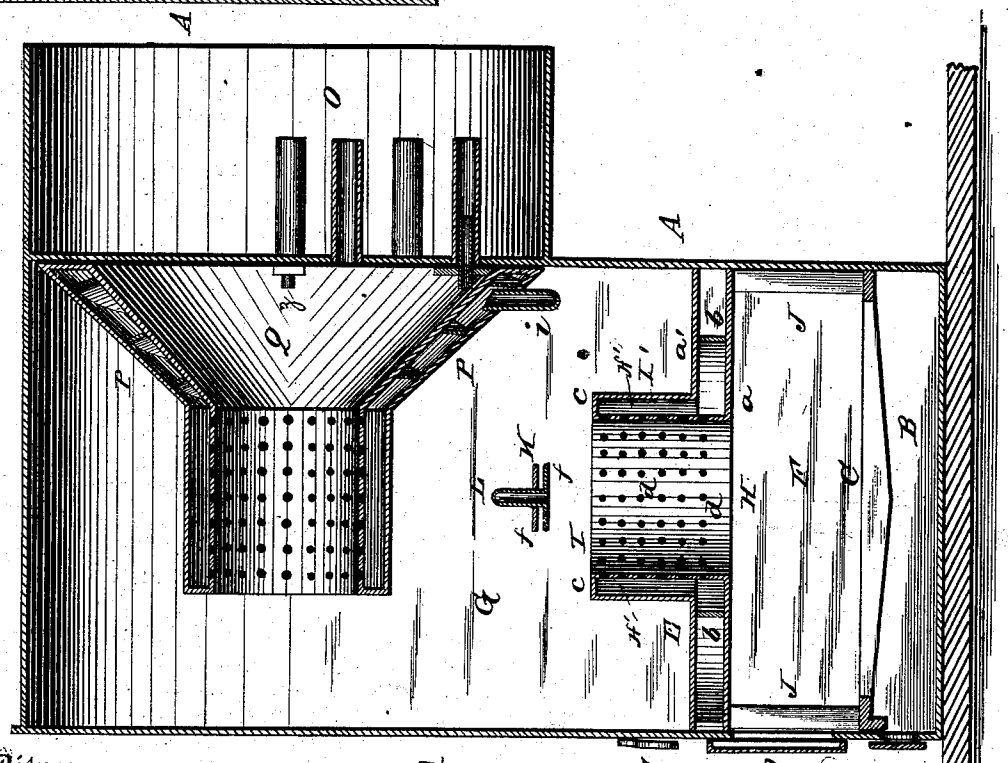

Fig. 3.

Witnesses:

P. L. Dietrick,

Wm. Dipperman.

Inventor

Virgil W. Blanchard,

Per C. A. Watson & Co., Attorneys.

UNITED STATES PATENT OFFICE.

VIRGIL W. BLANCHARD, OF WEYBRIDGE, VERMONT.

HYDROCARBON-FURNACE.

SPECIFICATION forming part of Letters Patent No. 239,706, dated April 5, 1881.

Application filed March 16, 1880. (No model.)

To all whom it may concern:

Be it known that I, VIRGIL W. BLANCHARD, of Weybridge, in the county of Addison and State of Vermont, have invented certain new and useful Improvements in Hydrocarbon-Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention consists in an improved furnace for burning ordinary fuel, such as wood, anthracite or bituminous coal, or for burning such fuel in combination with liquid fuel, or for burning liquid fuel alone, and in each instance realizing from the fuel used the most desirable results in the process of its combustion.

It also consists in the use of an air-heater of novel construction, that may be applied to the fire or fuel chamber of an ordinary furnace, by means of which a more perfect combustion of the fuel burned on the grate-bars may be realized than would be possible if burned by the usual method.

It also consists in a novel combination between the aforesaid air-heating device and an apparatus for conveying into the fire or fuel chamber and dispersing therein liquid fuel, and of surrounding the latter with the most favorable conditions for the process of ignition and combustion.

It also consists in a novel combination between the air-heater aforesaid and the fire or fuel chamber, the latter being provided with suitable openings, so that the ashes or unconsumed portions of the fuel that may be consumed in the fire or fuel chamber may be prevented from mixing with the fuel upon the grate-bars, and at the same time be easily removed from the fuel-chamber by the operator.

It still further consists in the combination, with the parts already enumerated, of a secondary air-heater similar in construction to the one aforesaid, by means of which a more perfect combustion of the fuel may be realized than would otherwise be possible.

It also consists in a combination between the elements aforesaid, and an air-heater, a fan, or air-pump, together with suitable pipes and stop-cocks, so that the ash-pit beneath the grate-bars and the two air-heaters aforesaid, together with the apparatus for dispersing liquid fuel, may be supplied with a current of heated air under pressure sufficient to enable each to perform the proper function devolving upon it.

It consists, lastly, in the use of an air-heater external to and separate from the fire or fuel chamber, in combination with the elements aforesaid, by means of which heat derived from the waste gases from the furnace, or from the exhaust-steam from the cylinder of a steam-engine, may be communicated to the current of air, in its passage from the fan or air-pump, before it enters the ash-pit and the air-heaters in the fire or fuel chamber aforesaid, thus utilizing it and realizing the greatest economy in fuel in the practical operation of the furnace.

In the annexed drawings, Figure 1 is a side elevation, partly in section. Fig. 2 is a front elevation, partly in section. Fig. 3 is a central vertical section, taken on line *x x*, Fig. 2. Fig. 4 is a horizontal section, taken on line *y y*, Fig. 2; and Fig. 5 is a sectional view of the disk.

A represents a furnace, having connected with it the ordinary tubular boiler.

B represents the ash-pit, and C the grate-bars, which do not differ from those in ordinary use.

D represents a door, through which fuel may be introduced into the fuel-chamber.

E represents a primary air-heater, and serves as a partition-wall between the fuel-chamber F and the primary combustion-chamber G, having an opening, H, that connects one with the other. It will be observed that the air-heater E is composed of the two plates *a a'*, having a spiral channel, *b*, formed between them, which connects with a cylindrical vertical cavity, H', formed by the tube I within the tube I', the said cavity between said tubes being closed at its extremity at *c*, and the wall of the inner tube, I, being provided with the perforations *d*, so that a current of air forced into the spiral column *b* of the air-heater E at its outside or marginal portion, (shown at *e*,) after passing through said spiral column, would be discharged through the perforations *d* into the tube I', that connects the fuel-chamber F with the primary

combustion-chamber G. It will be observed that the inner tube, I, is continuous with the lower plate of the air-heater *a*, and that the outer tube, I, is also continuous with the upper plate of the air-heater *a'*, so that these two tubes may be considered as a portion of the air-heater rising vertically with the primary combustion-chamber G. And I would be understood not to limit the length of these tubes, but desire to claim them of a length suitable to meet the want required of them. In the melting of ores and reducing of minerals their length might require to be extended, and the position of the air-heater E inserted in a suitable chamber, so that an action similar to a blow-pipe of the gases of combustion passing through them might be experienced by the substance to be melted or reduced beneath them. I would be understood to claim this as a necessary modification. Under certain circumstances the tubular portion of the air-heater E may be dispensed with, a single tube of sufficient length to connect the two plates of said air-heater being used as a substitute. By perforating the wall of this short tube the fresh heated air may be discharged into the cylindrical opening in said air-heater H precisely in the manner heretofore described. I would be understood to claim this modification as a substitute for the tubular extremity, heretofore clearly set forth.

J represents four columns or supporters to the air-heater E, extending through the fuel-chamber and resting on the grate-surface. Although the air-heater E is shown as firmly connected to the fuel-chamber F, still, under certain circumstances, it would be highly advantageous to have it separate from said chamber, supported, as shown, by the four upright columns. It may be used either as a permanent fixture or separate from the furnace.

K represents a disk composed of the two plates *f f'* closely approximating each other, the space between said plates being continuous with the pipe L, that passes out of the primary combustion-chamber G and enters the bottom of the receptacle M.

N represents a pipe passing downward into the receptacle M, and terminating by a free extremity near the free extremity of the pipe L, that enters the bottom of the receptacle M, so that a current of air or steam, or any suitable gaseous element or elements, passing from the steam-boiler O through said pipe N would enter the pipe L and be discharged in the primary combustion-chamber G in a lateral direction immediately above the cylindrical opening in the air-heater E. Hence, if liquid fuel should be introduced into the receptacle M it would, by its gravity, pass between the free extremities of the pipes L N, near the bottom of said receptacle, and be connected by a current of a gaseous element or elements passing through the said pipes L N into the primary combustion-chamber G, and be dispersed in a lateral direction by said gaseous element or elements directly above the cylindrical opening in the air-heater E. In certain cases, in the treatment and reduction of ores and minerals, it will be found necessary to dispense with the disk, and to inject the liquid fuel, either laterally or vertically, into the current of combustible gases as they issue from the cylindrical aperture H in the primary air-heater E, rather than dispersing them in a lateral direction by the disk K. In this case the disk K would simply require removal and the direction of the free extremity of the pipe L changed, if necessary, in its direction.

g represents two openings into the primary combustion-chamber immediately above the upper surface of the primary air-heater E, through which a proper instrument or tool may be introduced for the removal of the ashes or the unconsumed portion of the fuel that may be introduced into this chamber in the manner described through the pipe L from the receptacle M.

P represents a conical secondary air-heater constructed and fashioned like the primary air-heater F already described, with the exception that the two plates between which the spiral passage is formed are conical in form, instead of being a flat or plain surface, and that the marginal outline of said plates is cylindrical, instead of being square. It will be observed that this secondary air-heater P is movable, it being attached to the flue-surface of the tubular boiler O by three stout tubes, which enter three flues of said boiler, and may be removed by uncoupling the pipe *z*, that supplies air to its interior spiral column.

Q represents a secondary combustion-chamber, bounded by the flue-surface of the tubular boiler and conical wall of the secondary air-heater P. It will be observed that there is a continuous passage from the primary combustion-chamber G through the tubular cylindrical extremity of the secondary air-heater P, and thence through the secondary combustion-chamber to the flues of the tubular boiler O.

R represents a fan, to which motion may be communicated by means of the steam generated in the steam-boiler O, and properly applied to an ordinary steam-engine.

S represents a pipe leading from the fan R through the air-heater T. It will be observed that this pipe, in its passage through the air-heater, is coiled, as shown at *h*. It will still further be observed that the pipe S, after passing through the air-heater T, is divided into three branches, *i i' i''*, each provided with a stop-cock, *j j' j''*, and entering the ash-pit B, one connected with the spiral column of the primary air-heater E, and one connected with the spiral column of the secondary air-heater P. The air-heater T, it will be observed, is simply a cylindrical tube inclosing the coiled pipe S, and having at each end a free open extremity, permitting the passage of heated gases.

In the practical operation of my invention ordinary fuel, such as wood or anthracite coal, is introduced into the fuel-chamber F upon the grate-bars C and kindled. As soon as steam

is raised in the boiler O motion should be communicated by the engine to the fan R. At the same time the stop-cock in the pipe *i'* entering the ash-pit B and the stop-cock in the pipe *i'* entering the primary air-heater E should be opened, and the door entering into the ash-pit and the other entering into the fuel-chamber should be securely closed. As a result, a current of air will be forced by the fan R through the pipe S to the three branches *i i' i''*, and through the latter into the ash-pit B, and into the spiral column of the primary air-heater E. As a result, the fuel on the grate will be subjected to the process of combustion, and as the gases of combustion rise in the fuel-chamber, and are forced through the cylindrical tube or opening in the air-heater E into the primary combustion-chamber G, a fresh current of heated air will also be injected into them in their passage through the perforations in the wall of the inner tube of the air-heater E. By this means of injecting a current of fresh heated air into the combustible gases in the manner just described the process of combustion in such gases may be completed and a great saving of fuel realized.

It will be observed that the lower plate of the air-heater E is exposed directly to the greatest heat present in the fuel-chamber, and the upper plate of said air-heater to the intense heat present in the primary combustion-chamber, thus realizing in said air-heater the best possible means for heating to an intense degree the fresh air that is injected into the combustible gases as they pass from the fuel into the primary combustion-chamber.

In case that ordinary fuel—such as wood or anthracite coal—is used in the fuel-chamber F the secondary air-heater is not employed, the gases of combustion, without any further chemical change, would pass directly to the flues of the boiler O, and after traversing them would pass to the escape-flue of the furnace.

I would here remark that in furnaces of limited size the primary air-heater E may be formed of metal, as the current of fresh air passing through it will keep its temperature below the melting heat of iron; but for large furnaces, for the reduction of ores and minerals, it would be necessary that the surface of the air-heater E that is exposed to the heat of the primary combustion-chamber G be formed of or protected by furnace-brick or some material more refractory to heat than ordinary metal. In such a case the tubular portion of the air-heater would require to be applied to the lower surface of said heater, extending downward into the fuel-chamber, instead of upward, as shown, into the primary combustion-chamber, the construction of it, with this exception, remaining unchanged. I would be understood to describe this modification.

By the introduction of liquid fuel into the fuel-receptacle M, and at the same time by connecting the upright pipe N with the steam-boiler O or fan R, so that a current of air or steam, under pressure, is caused to flow rapidly and forcibly through said upright pipe N, it becomes evident that liquid fuel in the bottom of said receptacle M will be conveyed by said current of air or steam through the pipe L, and forcibly dispersed in a lateral direction between the two plates of the disk K immediately above the cylindrical opening in the primary air-heater E. It will be particularly observed that this disk K is located immediately above the cylindrical opening in the primary air-heater E, so that the dispersion of the liquid fuel would take place in the midst of the current of combustible gases as they pass upward from the cylindrical opening in the primary air-heater E into the primary combustion-chamber G, where the heat would be intense in degree and all the conditions favorable for the process of combustion; and I desire to use all forms of carbon or hydrocarbon that serve as fuel in the form of liquid fuel dispersed by the disk K or injected into the combustible gases, and also of all suitable gaseous elements, besides them, contained in air or steam in the dispersion or injection of said liquid fuel. Now, by the dispersion or injection of liquid fuel in the manner just described, it becomes evident that, with ignited fuel in the fuel-chamber beneath, ignition of the liquid fuel will readily take place after its dispersion from the disk K, or its injection from a pipe, and its combustion will commence in the primary combustion-chamber G. Then, by opening the stop-cock *i* in the pipe leading to the secondary air-heater P it becomes evident that the gases resulting from the combustion of the ignited fuel in the fuel-chamber and of the ignited liquid fuel will become mingled with fresh heated air supplied by said air-heater as they pass through the cylindrical tubular portion of said heater and be consumed in the secondary combustion-chamber formed between the inner surface of the secondary air-heater and the fuel-surface of the boiler O. Hence, it will be clearly understood that for ordinary fuel ignited in the fuel-chamber only the primary air-heater will be necessary to complete the act of combustion of said fuel; but for liquid or pulverized fuel, used either alone or in connection with ordinary fuel, the secondary air-heater will be necessary to complete the process of combustion. In the latter case the primary air-heater may, under certain circumstances, be dispensed with, although its use under certain conditions might prove a valuable auxiliary.

In the secondary air-heater the cylindrical tubular opening is shown directed toward the fuel-chamber, the reverse in direction of this tubular opening, as seen in the primary air-heater. I would here remark that under certain circumstances more than one opening may be found advantageous in the air-heater E to connect by a free passage the fuel with the combustion-chamber. In such a case each opening would require to be connected with the passage (spiral or otherwise) for heating the fresh air to be discharged into the combustible gases as they pass from the fuel into the combustion-

chamber. I would be understood as claiming this modification in the construction of the air-heater E.

Although the flues of a steam-boiler for the production of steam are shown as forming the channel for the practical use and application of the heat claimed from the combustion of fuel in the invention just described, still I would have it clearly understood that I desire to apply the said heater to the melting, reduction, and purification of ores or minerals, or for any use to which it may be applied in the arts.

By means of the two doors opening into the primary combustion-chamber G the ashes from and unconsumed portions of the fuel may be removed from said chamber with a proper instrument by the operator.

It will be observed that by this arrangement of the air-heater E, placed above the grate C in the manner described, the ashes and unconsumed portions of the fuel are prevented from falling upon the surface of the ignited fuel in the fuel-chamber, and thus hindering and obstructing its combustion. After the heat derived from the combustion of the fuel in the manner set forth has been applied to the production of steam, or the melting, reduction, or purification of ores and mineral, or for any other purposes for which it may be requisite, there still remains in the present methods of its application a certain amount or volume of the same that is unutilized, and which is allowed to escape in the exhaust-steam from the steam-engine and up the flue in the chimney in smelting and other processes in the arts. Now, by directing this volume of heat that would otherwise be lost through the air-heater E by a proper channel it becomes evident that a portion of it would be communicated during its passage through said heater to the current of air that is passing through the coiled pipe in said heater from the fan R, and be thus transmitted back to the furnace, which would effect a great economy in the use of fuel in the same.

I would here be understood to describe the application of waste heat, from whatever source, to the air-heater, if such an application should be considered desirable, for the purpose of securing its return to the furnace in the air supplied by the fan in the manner that has been described; and I would finally add that I desire to describe in this specification, as pertaining to my invention, not only the use of a single air-heater and combustion-chamber combined with a fuel-chamber, with or without an apparatus for dispersing fuel for burning certain varieties of fuel, but also this aforesaid device, in part or in whole, combined with a secondary air-heater and combustion-chamber, for the combustion of other forms of fuel, as the judgment of the operator may dictate; and I would further add that, for burning liquid fuel, in certain cases the fuel-chamber, as well as the primary air-heater, may be dispensed with, ignition of the liquid fuel being produced by an ordinary gas-jet or the combustion of tinder till the heat is sufficient to continue it.

I am aware that an air-heater consisting of a cylindrical tube having at each end a free open extremity and inclosing a coiled pipe is not new, but is embraced in another application by me now pending, and do not therefore claim such in this case.

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

1. The combination of the tubes I I′, forming an inclosed annular space, the inner tube having a perforated wall, with the air-heater E, whereby air is discharged into the air-heater for the purpose of heating the same for the combustion of fuel in a furnace, as set forth.

2. The air-heater E, composed of the plates *a a′*, having a spiral channel, *b*, formed between them for concentrating the combustible gases as they pass from the fuel-chamber, for heating fresh air for combustion, and for mingling the fresh-treated air with the combustible gases, as set forth.

3. An air-heater composed of the two plates *a a′*, having the spiral channel *b* formed between them, and also provided with the tubes I I′, having an inclosed annular space between them, the inner tube being provided with the perforations *d*, substantially as and in the manner set forth.

4. The air-heating device E, constructed as described, having a central opening for the concentration and discharge of combustible gases, and also for mingling with said gases fresh-heated air, in combination with the fuel-chamber F, substantially as and in the manner specified.

5. The primary combustion-chamber G, in combination with the air-heater E and disk K, for dispersing fuel, substantially as set forth.

6. The fuel-chamber F, air-heater E, and combustion-chamber G, in combination with a secondary air-heater, with disk K, pipes L N, and receptacle M, for dispersing fuel, as set forth.

7. The adjustable conical air-heater P, constructed and operated in the manner set forth, in combination with a combustion-chamber that is partly or wholly formed by the concavity within the wall of said air-heater, substantially as and for the purposes specified.

8. The pipes *i i″ i″* and stop-cocks *j j′ j″*, in combination with the ash-pit B and air-heater E, for controlling the flow of the gaseous element, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

VIRGIL W. BLANCHARD.

Witnesses:
HENRY P. SISSON.
FRANCIS HEAGANY.