Sheet 1 – 2 Sheets.

F. B. Blanchard,

Air and Steam Engine,

No. 13,209. Patented July 10, 1855.

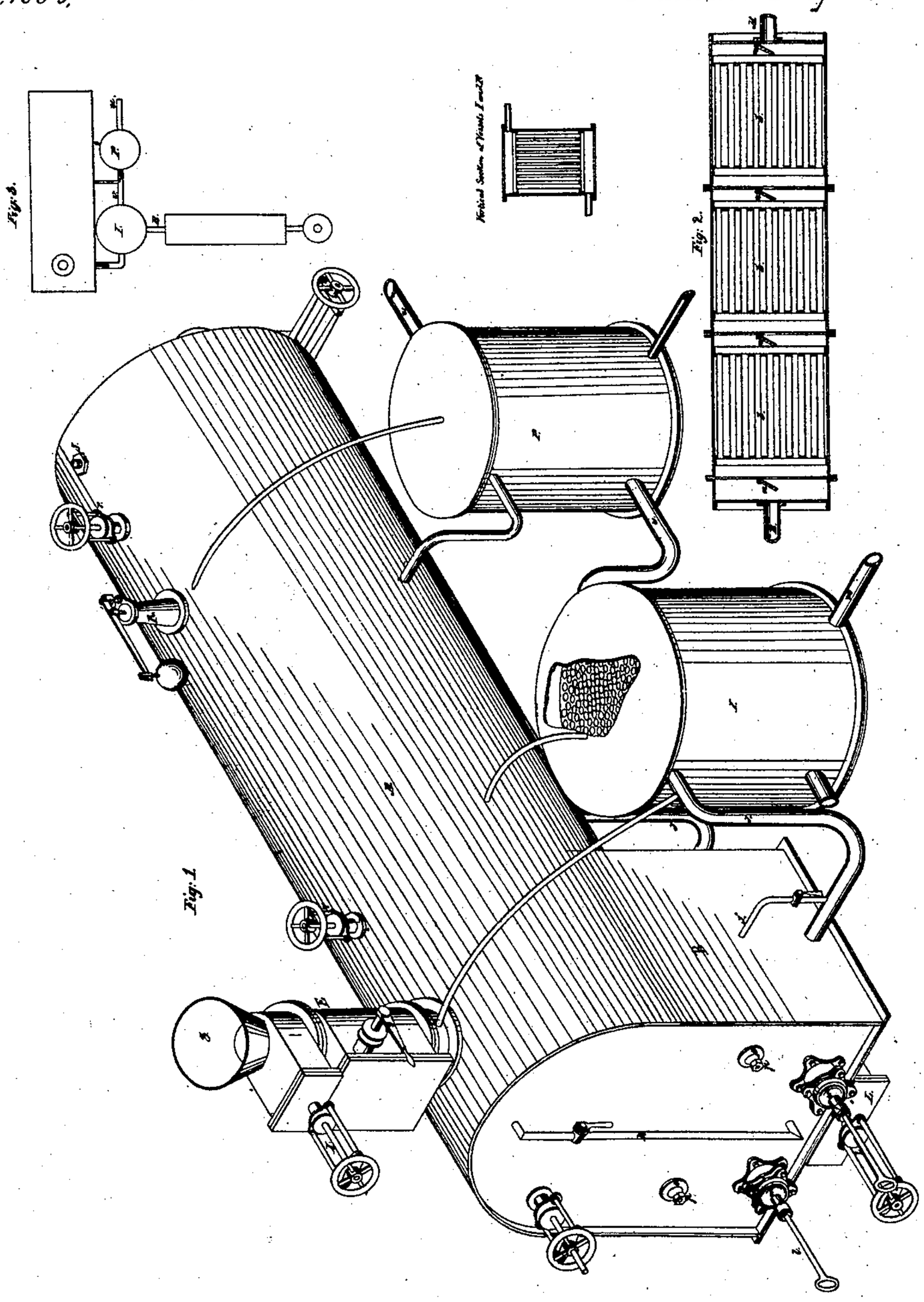

Fig. 1.

Fig. 3.

Vertical Section of Vessels I and H

Fig. 2.

Sheet 2 - 2 Sheets.

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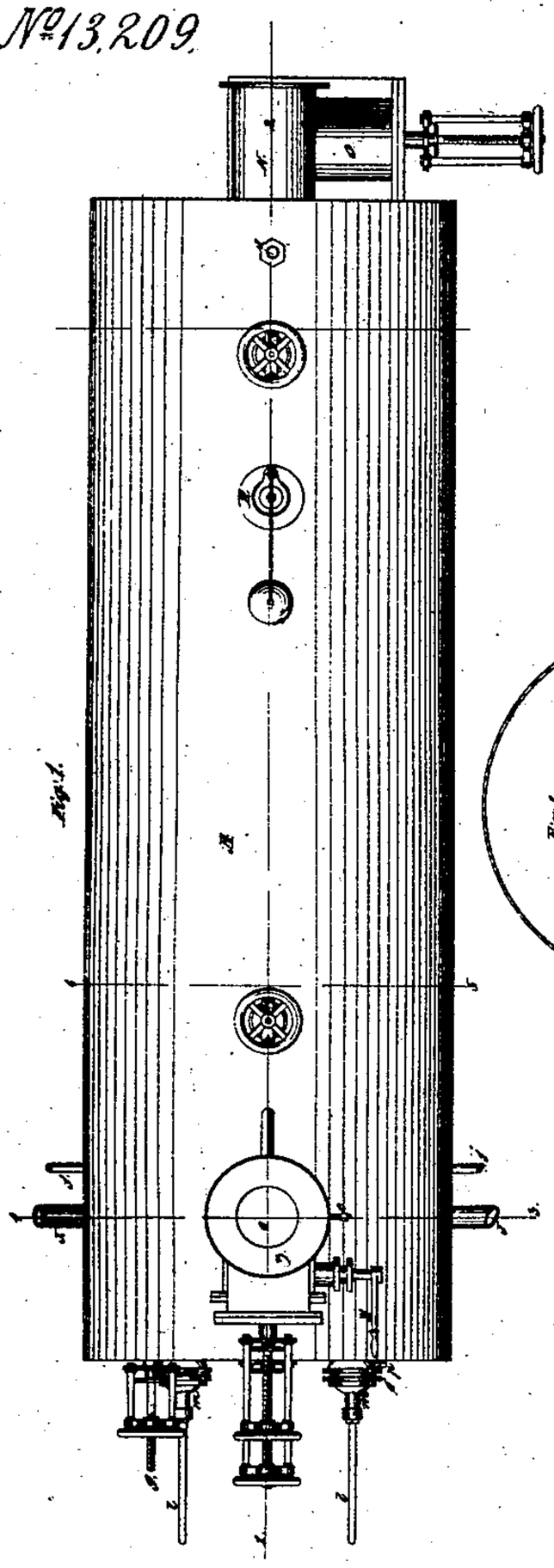

Fig. 1.

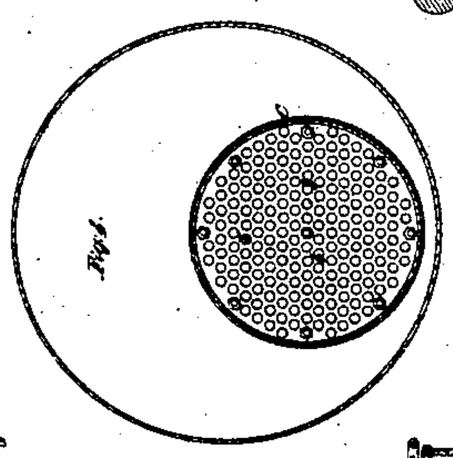

Fig. 4.

Fig. 2.

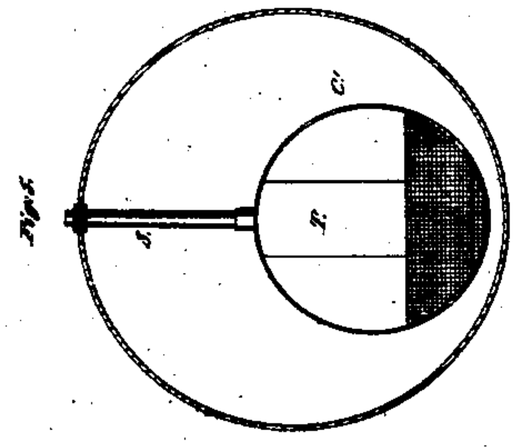

Fig. 5.

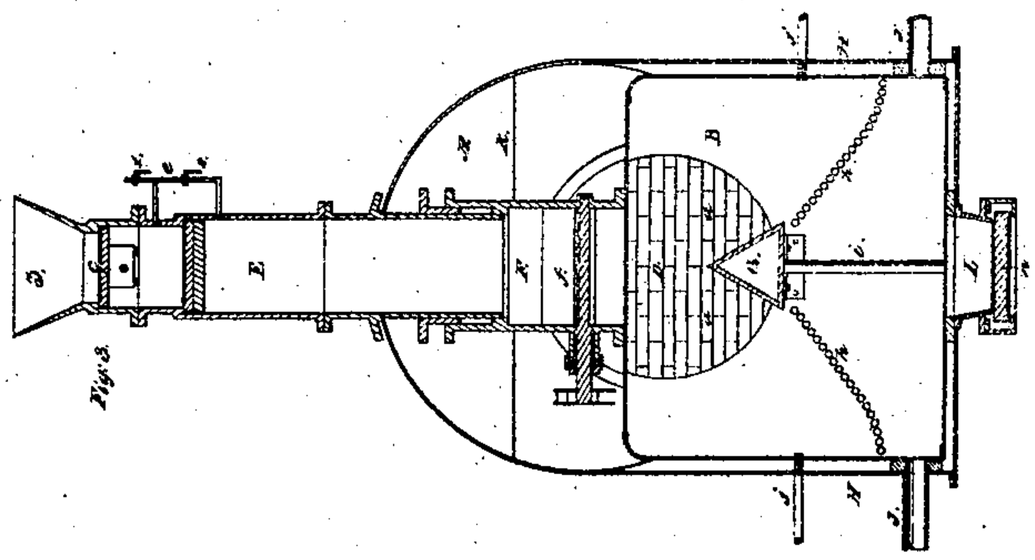

Fig. 3.

UNITED STATES PATENT OFFICE.

F. B. BLANCHARD, OF WATERVILLE, MAINE.

AIR AND STEAM ENGINE.

Specification of Letters Patent No. 13,209, dated July 10, 1855.

To all whom it may concern:

Be it known that I, FRANCIS BROWN BLANCHARD, of Waterville, in the county of Kennebec and State of Maine, have invented a new and useful Apparatus for Generating Motive Power from Heated Air, Steam, and the Products of the Combustion of Coal or other Fuel; and I do hereby declare that the same is fully described and represented in the following specification and the accompanying drawings, letters, figures, and references thereof.

Of the said drawings, Figure (Sheet 1) is an isometrical view of my invention. Fig. 2, (Sheet 1) is a longitudinal and central section of an air condenser to be hereinafter described. Fig. 1, (Sheet 2) is a top view of the boiler of my invention. Fig. 2, (Sheet 2) is a vertical central and longitudinal section of the said invention, said section being taken through the line 1, 2, of Sheet No. 2. Fig. 3, (Sheet 2) is a vertical and transverse section of the invention it being taken on the line 3, 4, of Fig. 1. Fig. 4, is a transverse and vertical section of the invention taken through the line 5, 6, of Fig. 1. Fig. 5, is a similar section taken on the line 7, 8, of Fig. 1.

By this apparatus it is intended that the smoke arising from combustion shall be consumed within a closed furnace and in connection with compressed air introduced within the furnace. The same may be said with regard to the volatile products of combustion that are susceptible of being consumed by heat. The volatile products that are not combustible being made to pass through the flues and to yield a portion of their heat to the water of the boiler so as to aid in the formation of steam while they are subsequently united with steam and used in connection therewith as an effective force or motor for operating the piston of a steam engine cylinder. The exhaust from the engine is to be caused to pass through a tubular feed water vessel (in communication with the boiler) and from thence through an air vessel of similar construction made to communicate with the furnace. The exhaust enters the top of each vessel and passes off at the bottom of each. The colder portion being the heavier passes off while the lighter and hotter portions remaining in the vessel until it has expended its heat when it will pass downward and give place to other portions that may be flowing into the vessel. Steam if formed in the water vessel will pass into the boiler. In this manner a portion of the heat which would otherwise be lost in the exhaust is carried back into the boiler and furnace and again made to do duty.

Having thus premised I will proceed to explain the peculiar features of my invention, wishing it to be understood that the same letters of reference are intended to exhibit like parts in the several figures.

A, is the boiler made in form somewhat like that used in ordinary locomotive steam engines and provided with a fire box, B.

c, *c′*, are cylindrical or other proper shaped chambers for collection of the volatile products of combustion. The first of these chambers is separated from the fire box or furnace by a brick partition D, having openings, *a*, *a*, for the volatile products of combustion to pass from the fire box into the chamber, C. Said two chambers, C, C′, are connected by a stock of hollow tubes or pipes, *b*, *b*.

E is a pipe through which the fuel is supplied to the fire box; such pipe being supplied with two valves, viz, a slide valve, *c*, and a hinged valve, *d*.

e is a pipe for relieving the valve of the pressure during the operation of charging or supplying the fire-box with fuel. This pipe has two cocks, 1, and 2, and is made to connect or open into the spaces directly above and below the valve *d*, as seen in Fig. 3, (Sheet 2).

The valve *c*, is opened or closed by means of a screw *x*. The fuel is put into the pipe, E, through a tunnel, *z*, at its top and rests on the valve, *d*, the valve, *c*, being supposed to be open. This being effected the valve, *c*, is to be closed and the cock, 2, in pipe *e*, to be open. This operation will equalize the pressure on the opposite sides of the valve *d*, and permit said valve to be let downward by means of its handle, *y*, so as to discharge into the furnace the fuel that may be resting upon it. Next, the valve, *d*, and cock, 2, are to be closed and the cock 1 opened thereby not only causing pressure to be exerted on the valve, *d*, but relieving the valve, *c*, so that it may be open preparatory to another charge of fuel being thrown into the mouth Z.

F, is a rectangular or other proper shaped chest or chamber situated at the lower end of, and making part of the pipe E, and

made to open into the fire box B. This chest is provided with a fuel distributer *f*, which is a turning plate or valve operated or turned by means of a screw *g*. By setting this distributer at any desirable angle the fuel that drops through the pipe, E, may be reflected or distributed in a longitudinal direction to any desirable part of the furnace. The transverse distribution of the fuel may be effected by means of a hollow ridge or vessel G, (formed triangular in cross section) assisted by the inclination of the grate bars *h*, *h*, which are arranged in the furnace as seen in the drawings. These grate bars are to be formed of wrought metal pipes and made to communicate with the water space, H, H, surrounding the fire-box, the water of the boiler being sufficient to flow freely through the pipes. The water is also made to freely circulate through the ridge or hollow vessel, G, by means of pipes, *i*, *i*, one passing out of its top and the other out of its bottom and being made to open into the water space of the boiler.

Air is to be supplied to the furnace by means of one or more air pumps, by which it is to be made to flow into the receiver, I, see Fig. 1, (Sheet I) and from thence by pipes J, J and *j*, *j*, into the furnace, it being carried both above and below the fire grate as seen in Fig. 3, (Sheet 2).

k, Fig. 1, (Sheet 1) is a pipe made to communicate with the steam space in the boiler, and that part of the fire box which is under the grate, such pipe being for the purpose of conveying steam to the furnace.

The line K, denotes the water line of the boiler.

l, *l*, are pokers or rakers operated through air tight universal joints, *m*, *m'*. These pokers are used for cleaning the grates of ashes and raking the same into the valve chamber L, said pokers or rakes being constructed in any suitable manner to enable such to be easily accomplished. The said chamber L, is provided with a slide valve, through the opening of which the refuse of the grates may be removed from the fire-box as occasion may require.

The furnace is provided with sight tubes, *o*, *o*, which are formed tapering and respectively provided with disks of plate glass or other suitable transparent material held in place by nuts *p*, *p*, and proper packing.

g, *g*, are cocks for the discharge of ashes from the chambers, C, C, such cocks being applied to such chambers or tubes leading out of the same as seen in Fig. 2 (Sheet 2). The chamber C', is provided with a net-work partition or perforated diaphragm, T, the object of which is to prevent the passage of ashes or cinders into the pipe N, leading out of said chamber.

M, M, are pipes passing from the steam space of the boiler into the chambers C, C', such pipes being provided with valves on their upper ends as seen in Fig. 2 (Sheet 2). These valves are operated or raised and depressed by screws *r*, *r*. By means of these pipes steam from the boiler can be admitted to the chambers, C, C', in order that it may be mixed with the gases, air, or volatile products of combustion that may be therein.

s is a tube that extends downward through the boiler into the chamber C'. This tube is closed at its lower end and open at its upper end in order that a thermometer may be suspended in it for the purpose of ascertaining the temperature of the steam, air and gases previous to the passage of the same into the engine.

N, Fig. 2 (Sheet 2) is the eduction pipe that leads from the chamber, C', to the engine or the valve chest of the cylinder thereof. This pipe has a branch pipe O, which contains a slide valve *t*, that may be opened when the valve of the engine pipe is closed, such engine pipe being supposed to be provided with a closing valve. The valve, *n*, beneath the furnace is likewise opened at the same time, this latter valve allowing a free admission of air into the furnace while the former permits the escape of the gases, during the process of setting the fuel on fire or during any temporary suspension of the action of the air pump.

The heater for the feed-water is seen at P. It is constructed like the air heater, I, that is to say it is the cylindrical vessel divided into three chambers by two horizontal partitions, between which a stack of pipes extends and opens free communication between the two external chambers. The said heater, P, is placed between the boiler and feed pump. The exhaust of hot air, gases and steam from the engine should be made to pass into the heater by a pipe, *u*, see Fig. 1, (Sheet 1), which opens into the middle chamber thereof. The exhaust thus surrounds the tubes of the heater or is in contact with their external surfaces, while the feed water occupies the two external chambers and the internal parts of the tube. From the internal chamber the exhaust or air gases and steam pass off by the pipe, *v*, into the air receiver I, and surround the tubes externally as in the water heater. The cold air is made to pass from the air pump through the pipe, *w*, and into the air receiver, I, and through its tubes and from thence into the furnace by the pipes, J, J, becoming heated during its progress through the tubes by the caloric imparted to them by the exhaust which is allowed to flow from the air heater into the atmosphere or into pipes to heat buildings.

Upon the boiler I have placed a safety valve, R. Between the air pumps and the air receiver, I, I sometimes make use of what I term an air condenser, which is rep-

resented in vertical and longitudinal section in Fig. 2 (Sheet 1). It is a cylindrical vessel divided by cross partitions into several compartments *b*, *b*, *b*, which are connected by openings in their partitions respectively provided with valves, *a*, *a*. Each of the compartments, *b*, has a stack of pipes extending through it, which are supported in partitions extending transversely across the interior of the air condenser, the same being as seen in the drawings. Each end of the condenser is provided with a pipe as seen at, A, and, B, the air from the air pumps being made to pass into the vessel by the pipe A, and by the pipe B, to proceed from it into the air receiver, I. The external surfaces of each tube of the stacks of the condenser are to be kept in contact with cold water in order that when air is passed through the pipe, the temperature of it may be reduced and the resistance on the air pumps proportionably decreased.

The two pipes M, M, leading from the steam space into the chambers, C, C′, are not only to admit steam into the chambers C, C′ so as to commingle with the gases of the furnace, but they are for the purpose of regulating the temperature of the mixture before it is made to enter the engine. Provided the steam be admitted into the chamber nearest the furnace it will take up a portion of the heat therein, thus reducing the heat of the gases thereof and increasing the rapidity of the current passing through the stack of pipes into the chamber, C′. Such an increase in the velocity of the current will of course cause it to yield up less of its heat to the tubes than would result were it to remain longer in contact with them.

In case we admit steam into the chamber C′, the volume to pass through the tubular stack will be diminshed, consequently its motion will be slower and after it has expended most of its heat in the tubular section or stack, it will come in contact with the steam, to which it will yield a portion of its heat until the temperature of the mixture is equalized. The tubes can be constructed with such length and surface as may be found to enable them to operate to the best advantage.

The tubular air receiver shown in Fig. 2 (Sheet 1) was described, as being divided into compartments with a valve to each of them. The design of this is that the air which may be lodged in each section, at each stroke of the air pump shall be held from going back out of the same. As the pipes of such sections or compartments are brought in contact with water colder than that of the atmosphere in the air condenser the air from the air pump will not have the same resistance in the whole stroke, as the valves will successively open according as heat has been thrown off in the sections during the time the air pump is making its return stroke.

In operating with my apparatus, the furnace is to be chaarged with coal or fuel, which being ignited bellows may be used to promote combustion, or the valve under the ash pit may be opened so as to admit air to the fire until the fuel is thoroughly kindled. Under these circumstances, the valve or cock of the pipe communicating with the engine should be closed, and the valve, *t*, of the branch communicating with the chimney opened, until the combustion is active enough to consume the combustible gases. This done the chimney valve should be closed, the engine valve opened and the engine put in motion. The valve, *n*, should be closed, and the air to the furnace be supplied by the air pumps. When the steam is up it should be allowed to flow from the steam space into either of the chambers, C, C′. If more expansive force and less evaporation is wanted, the steam and a portion of air should be admitted to that chamber which is nearest to the furnace. If more evaporation and less expansion be dsired the steam should be admitted to the other chamber, allowing the heat of the gases in the chamber, C, to expend itself in the water. The said two chambers and their pipes M, M, thus operate as a regulator of the temperature of the mixture of steam, air and gases to be introduced into the engine steam being admitted to the gases through either or both of the pipes and in such quantities as occasion may require. The pipes of the stack should be long enough or there should be a sufficient quantity of them to reduce the temperature of the gases low enough to enable them to be passed through the engine with the steam without injuriously affecting the lubricating matter applied to the piston.

A regard to the preservation of the oil or lubricating matter of the piston should be specially had in this apparatus, and hence the employment of the tube, S, for ascertaining the temperature of the mixture of gases, air and steam. The air from the air vessel or a due proportion of such air may be employed to reduce the temperature of the gases using the expansive force of the air and tempering down the heat to a using point. Making the apparatus almost entirely an air engine, the water surfaces of the boiler serving to preserve the heat from injuring it while what steam may be formed is used expansively.

In Fig. 3, (Sheet 1) I have exhibited a top view of the boiler and its furnace, the air and water vessels, I, and P, the air condenser, and the air pump, they being therein represented in their positions with respect to each other. I would remark how-

ever, that when the air condenser is dispensed with, the air from the air pump is to be led directly into the vessel, I, through its pipe, *w*. (See Fig. 1, Sheet 1.) Such pipe, *w*, and such figure corresponding with the pipes B, of Figs. 2, and 3.

I claim—

1. So arranging the boiler and stack of tubes *b*, *b*, *b*, or their equivalent the two chambers C, C′, and their respective connection pipes, M, M′; such chamber pipes, and stack of tubes being used for the purpose of regulating the temperature of the mixture of steam and gases or producing results substantially as specified.

2. I also claim in combination with the air pump and the furnace the tubular air condenser constructed substantially as described and for the purpose of reducing the heat of the condensed air and relieving the air pump from back pressure substantially as set forth.

3. I claim combining with the coal feeder the distributing valve, *f*.

4. I do not claim hollow grates, but I claim arranging them on an angle as described in combination with arranging them with and directly under a fuel supplying tube or hopper so that the fuel dropped out of the latter and upon the inclined grates may be distributed laterally by them as set forth.

5. I claim the combination of the water surfaces of the closed furnace with an extension of the water surfaces substantially as described, in such a manner as to produce, and for the purpose of producing a nearly or quite uniform temperature of and the power to regulate and control the temperature of subsaturated steam and the products of combustion for the supply of an engine.

In testimony whereof, I have hereunto set my signature this twenty-fourth day of October, A. D. 1854.

FRANCIS BROWN BLANCHARD.

Witnesses:

R. H. Eddy,

F. P. Hale, Jr.