(No Model.)

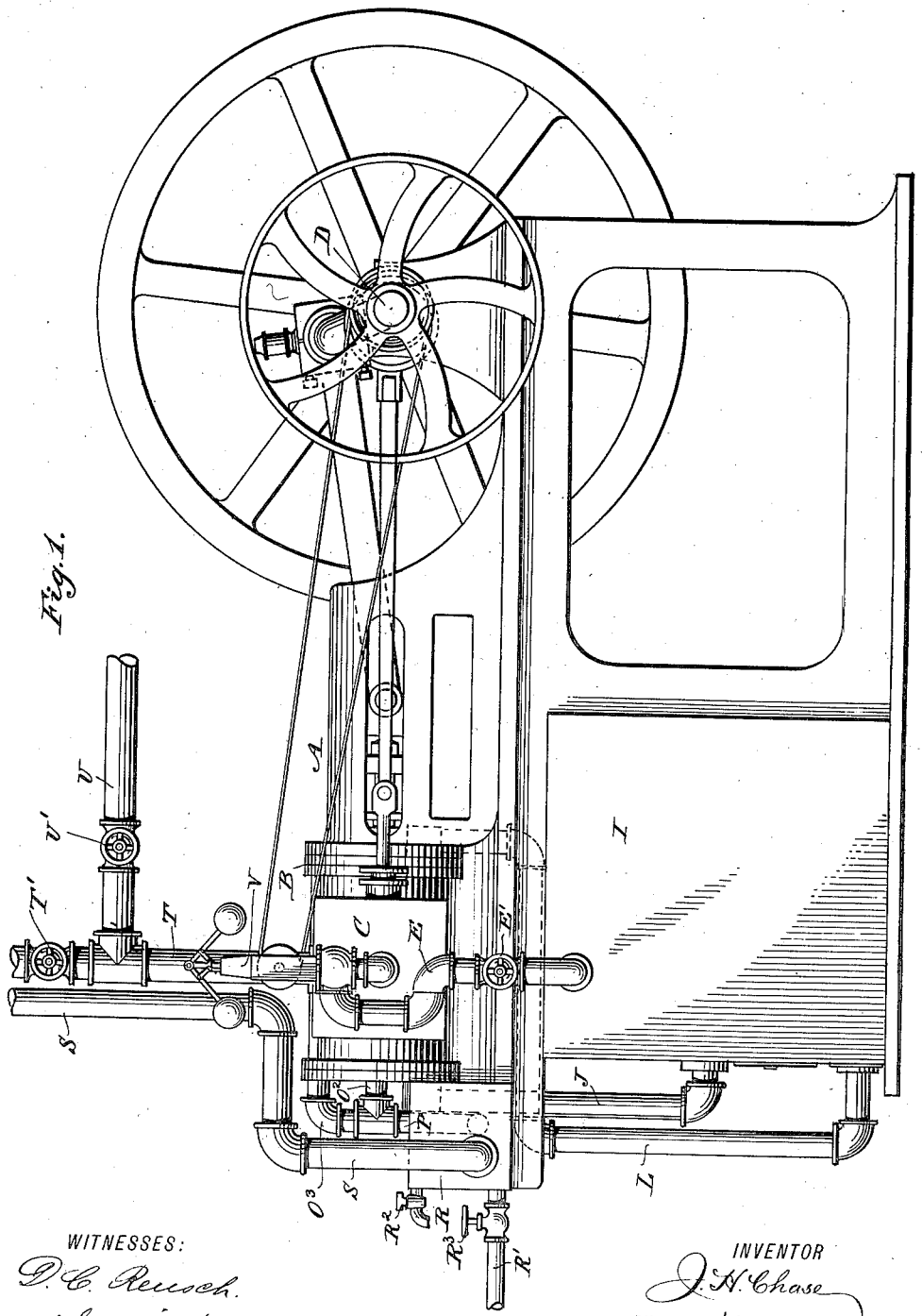
4 Sheets—Sheet 1.

J. H. CHASE.

HOT AIR ENGINE.

No. 417,857. Patented Dec. 24, 1889.

Fig. 1.



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HOT AIR ENGINE.

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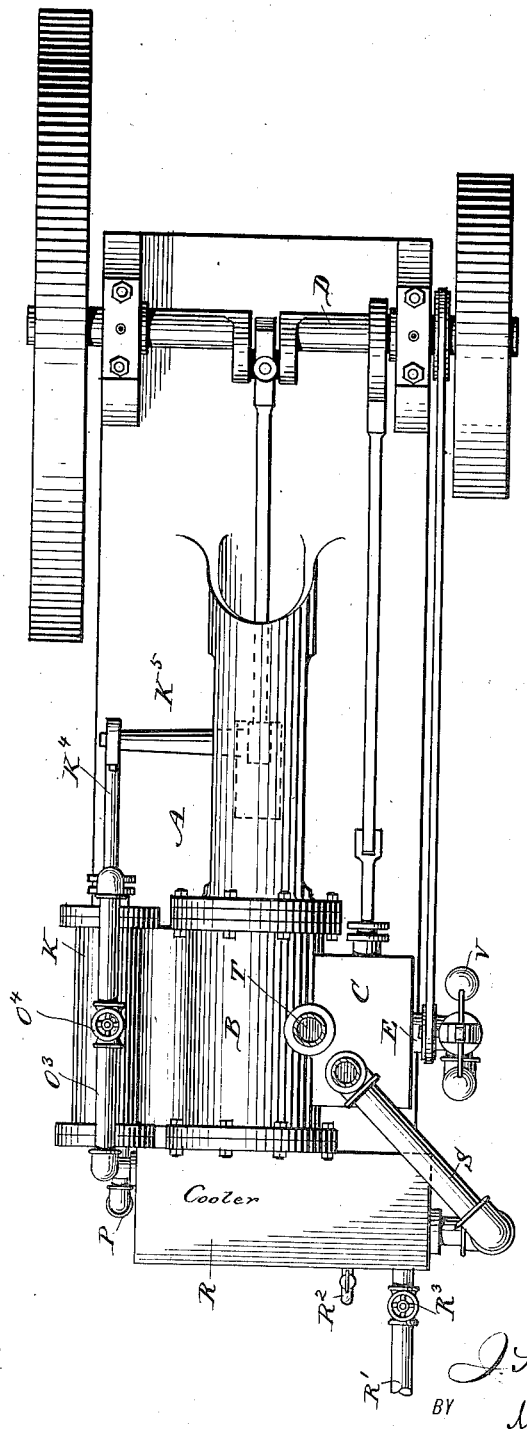
Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

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Fig. 3.

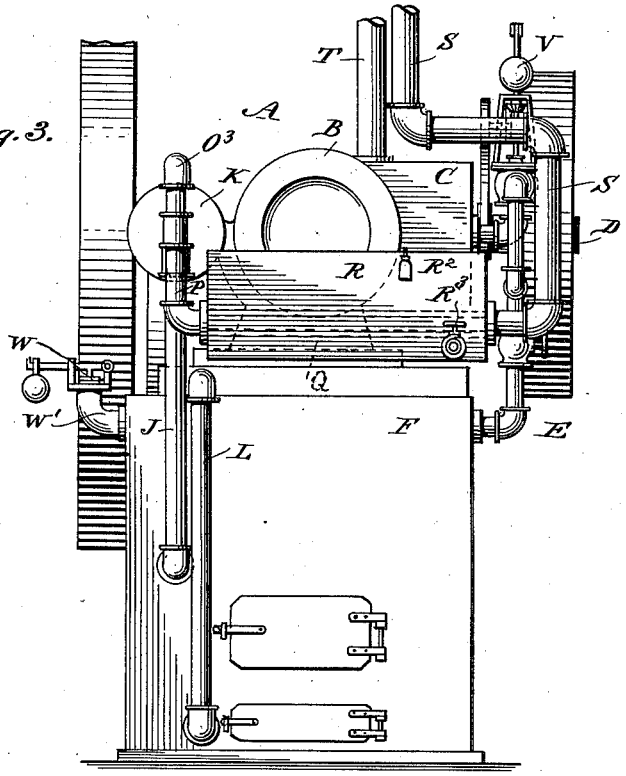

Fig. 7.

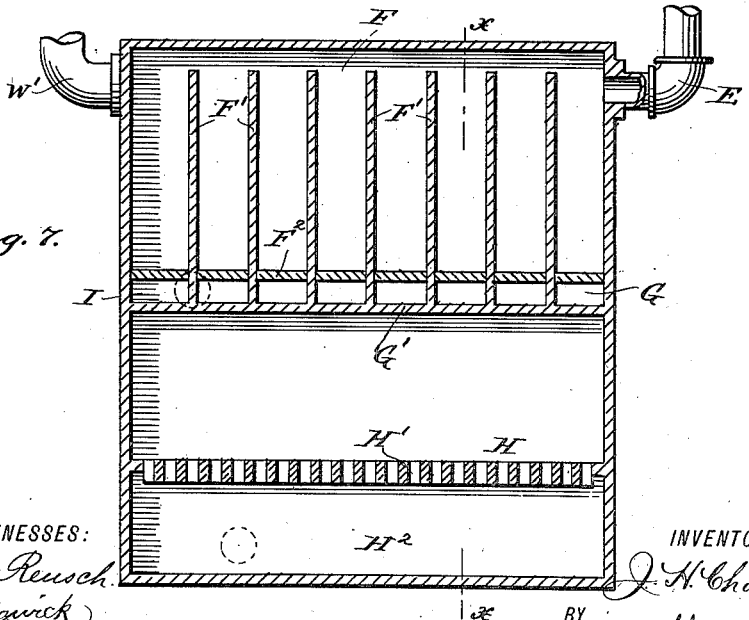

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Fig. 4.

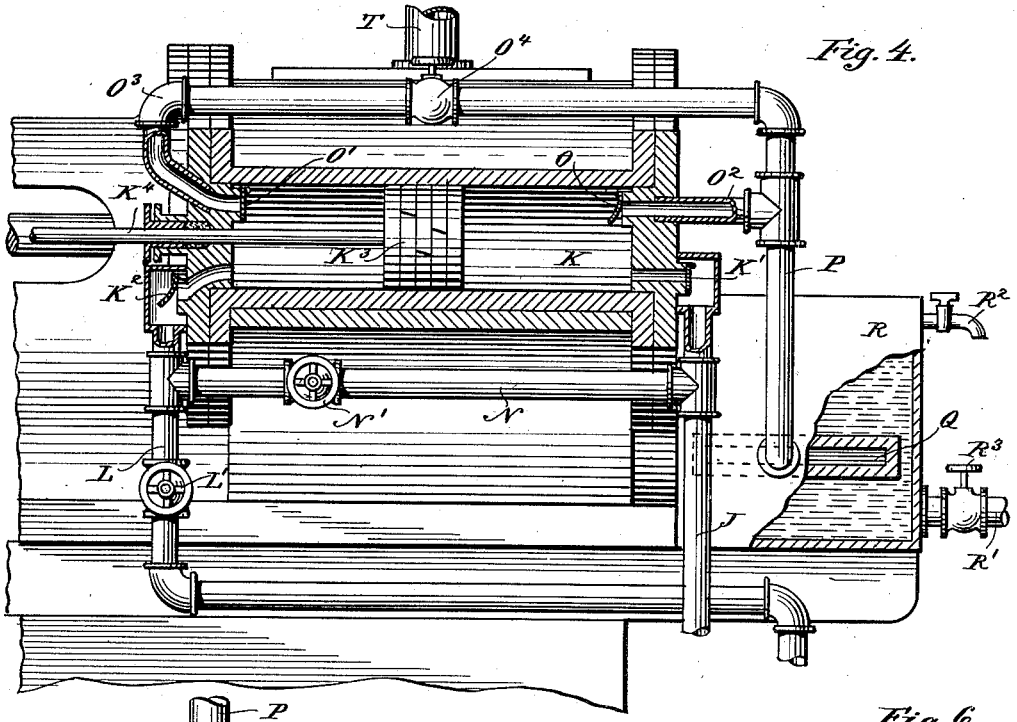


Fig. 5.

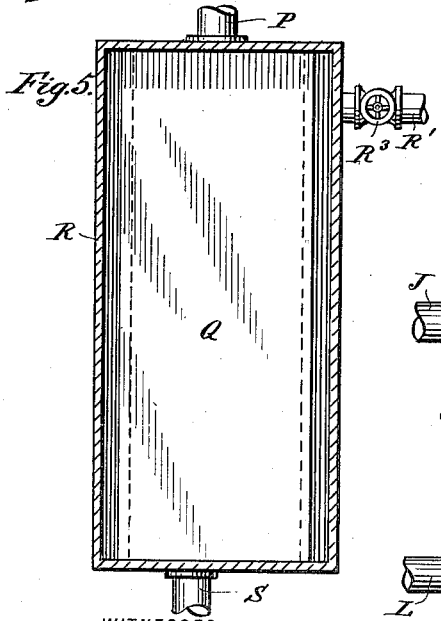
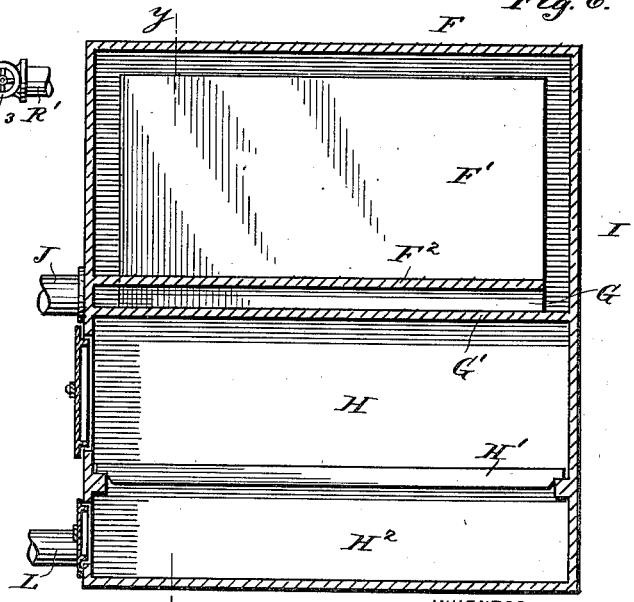


Fig. 6.



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UNITED STATES PATENT OFFICE.

JEROME H. CHASE, OF BUFFALO, NEW YORK.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 417,857, dated December 24, 1889.

Application filed May 17, 1889. Serial No. 311,100. (No model.)

To all whom it may concern:

Be it known that I, JEROME H. CHASE, of Buffalo, in the county of Erie and State of New York, have invented a new and Improved Hot-Air Engine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved hot-air engine which is simple and durable in construction and very effective and double-acting in operation.

The invention consists of an engine connected with a hot-air reservoir, a heater located under the reservoir, a furnace for heating the said heater, and an air-compressor operated from the engine and adapted to discharge into the said furnace and into the heater.

The invention also consists of certain parts and details and combinations of the same, as will be fully described hereinafter, and then pointed out in the claims.

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

Figure 1 is a side elevation of the improvement. Fig. 2 is a plan view of the same. Fig. 3 is an end elevation of the same. Fig. 4 is an enlarged sectional side elevation of the air-compressor. Fig. 5 is an enlarged sectional plan view of the cooler. Fig. 6 is an enlarged sectional side elevation of the furnace, heater, and reservoir on the line $x\ x$ of Fig. 7; and Fig. 7 is a sectional end elevation of the same on the line $y\ y$ of Fig. 6.

The improved hot-air engine is provided with an ordinary engine A, comprising a cylinder B and hot-air chest C, operating in conjunction with the said cylinder, which latter is provided with the ordinary piston connected in the usual manner with the main driving-shaft D. The main driving-shaft D is provided with suitable mechanism for imparting a sliding motion to the ordinary slide-valve held in the chest C.

Into the hot-air chest C leads a pipe E, provided with a valve E′, and connecting with the upper end of a hot-air reservoir F, below which is located the heater G, under which is held the furnace H, the latter as well as the heater and the reservoir being inclosed in a single casing I, preferably located directly under the cylinder B of the engine A.

The reservoir F is provided with a number of longitudinally-extending parallel plates F′, extending through the bottom F^2 of the said reservoir onto the bottom G′ of the heater G, said bottom G′ forming the top of the furnace H. The longitudinally-extending plates F′ terminate a short distance from each end of the casing I and also a short distance from the top of the same, Figs. 6 and 7. The bottom F^2 of the said reservoir F connects with the front end of the casing I and terminates at the ends of the said plates F′.

The furnace H is provided with the usual grate-bars H′, below which is arranged the ash-pit H^2. The usual doors are formed on the furnace H and in its ash-pit H^2, as is plainly shown in Figs. 3 and 6.

Into the front end of the heater G opens a pipe J, which extends upward and connects by a discharge-valve K′ with one end of the air-compressor K, arranged beside the cylinder B. On the other end of the air-compressor K is held a discharge-valve K^2, opening into a pipe L, provided with a valve L′, and leading into the ash-pit H^2 of the furnace H. The pipes L and J are connected with each other by a pipe N, provided with a valve N′, said pipe N opening into the pipe L between the valve L′ and the discharge-valve K^2.

The cylinder of the air-compressor K is provided with the usual piston K^3, carrying a piston-rod K^4, connected at its outer end with a post K^5, projecting from the cross-head of the engine A, so that when the latter is in operation it imparts a sliding motion to the piston K^3. In the heads of the cylinder of the air-compressor K are also arranged the inlet-valves O and O′, of which the former opens into a pipe O^2 and the latter opens into a pipe O^3, provided with a valve O^4. The pipes O^2 and O^3 both admit air from a pipe P, extending downward into a closed reservoir Q, located inside of a cooler R, arranged on the outer end of the cylinder B directly above the casing I. The cooler R is provided with a water-inlet pipe R′, connected with a suitable source of water-supply and provided with a valve R^3. From the top of the cooler

R extends a faucet R^2, for discharging the water after it has been heated. The reservoir Q opens into a pipe S, extending upward into the open air, so that the air-compressor draws fresh air into the cylinder when in operation.

The cylinder B of the engine A discharges into an outlet-pipe T, leading to the outside and provided with a valve T'. Directly below the valve T' is connected a pipe U, also provided with a valve U', and discharging into a room to be heated by hot air. The inlet-pipe E of the engine A is provided with the usual governor V, operated from the main driving-shaft D of the engine A. A pipe W' leads from one end of the hot-air reservoir F, and is provided with an exhaust-valve W to prevent an excess of hot air in the said reservoir F.

The operation is as follows: A fire is started in the furnace H on top of the grate-bars H', so that the air naturally present in the hot-air reservoir F is rapidly heated by the heat from the furnace H radiating from the plates F', extending in the said reservoir F. When the pressure in the reservoir F is sufficient, (which may be determined by a gage not shown in the drawings,) the valve E' is opened, so that the hot air passes into the hot-air chest C and from the latter into the cylinder B, so that the piston in the same is moved forward and backward in a manner similar to the movement of a horizontal steam-engine, whereby the main driving-shaft D is rotated. The exhaust from the cylinder B passes through the pipe T and may be discharged into the open air when the valve T' is opened; or when the latter is closed and the valve U' is opened the exhaust of hot air may pass through the pipe U into a room in order to heat the same, thus fully utilizing the exhaust hot air. The motion of the engine A imparts a forward and backward sliding motion to the piston K^3 in the air-compressor K, so that air is drawn into the said cylinder through the pipe P and the branch pipes O^2 and O^3. The air drawn into the air-compressor is pure fresh air derived from the outside, and the said air is also cooled by passing through the reservoir Q, surrounded by cold water in the cooler R. The air from the air-compressor is discharged through the valves K' and K^2 into the pipes J and L, of which the latter leads the air into the ash-pit H^2 of the furnace H, so that a current of air is passed under and through the grate-bars H' into the burning fuel to aid combustion. The smoke and gases arising in the furnace H are carried off through a suitable pipe leading from the said furnace. The compressed and discharged air in the pipe J passes from the latter into the heater G, in which it is heated by the heat of the furnace H. After passing through the heater G it passes into the reservoir F, and from the latter through the pipe E into the hot-air chest C, as before described.

When it is desirable that no air should be supplied to the ash-pit H^2, the operator closes the valve O^4 in the pipe O^3, so that one end of the cylinder of the air-compressor K will not receive a supply of air, and consequently no air will be discharged through the discharge-valve K^2 into the pipe L. When the valve N' in the pipe N is opened, the valve L' in the pipe L is closed, and vice versa. When the valve N' is closed and the valves L' and O^4 are opened, then the air from this end of the cylinder of the air-compressor K passes to the ash-pit H^2, as before described. When, however, the valve L' is closed and the valve N' is left open, then the air from this end of the cylinder is discharged through the pipe N into the pipe J, whereby all of the compressed air of the air-compressor K passes to the heater G. This is done when an extra supply of compressed air is needed for the heater to give increased power, and no air is required for the furnace to aid the same in the combustion of its fuel. The arrangement of the pipes and valves just described enables the operator to increase or diminish the supply of cold condensed air to either the heater or the furnace.

It will be seen that in this engine the motive agent used is the atmosphere taken in a perfectly natural state and subjected to a process which first rapidly cools it and then condenses it and forces it into a heater heated by the intense heat of the furnace, so that the air is rapidly heated and furnishes a power which is utilized for driving various kinds of machinery. It will further be seen that this engine does not use any gas or other products of combustion as a portion of the power, but only uses hot air which is taken in a pure state and is kept pure throughout the operation; also, that the air is received and discharged continuously during the operation of the engine. It will further be seen that the engine A is double-acting instead of single-acting, as is the case with other engines of this kind; and it will also be seen that by means of the pipes and their valves connecting with the air-compressor the air-pumping capacity of the engine is placed entirely under control, whereby the operator is enabled to increase or diminish the power at will by throwing a greater volume of air into the heater, which also has the effect of greatly lessening the loss of power caused by pumping the air, so as to balance or equalize the pressure on both sides of the piston of the air-pump. It further enables the operator to increase the power by getting a strong side draft through the pipe L directly into the furnace when necessary.

The cooler is so constructed that air drawn from the outer atmosphere to fill the vacuum naturally created by the operation of the air-compressor is made to pass in a very thin broad sheet between metal plates near the bottom of a long vessel containing cold water, so that the air is rapidly cooled. The air is

then rapidly heated by being made to pass through a low heater located directly above the furnace. The air then passes into a reservoir, where it is still further heated by means of metallic plates which extend from the top of the furnace, thus directly conducting the intense heat of the furnace into the reservoir itself, thereby causing the air to receive considerable additional heat, and also to retain its heat in the reservoir all the time that the furnace is in operation, whether the engine itself is in operation or not. This makes the engine much more certain in its action, as the reservoir receives a constant supply of heat through its metallic plates and at the same time gets a steady supply of air from the outer atmosphere, and is always filled with air.

As pure out-of-door air is pumped into the engine and no products of combustion of other things injurious to health are allowed to mingle with it at any time the air after having done the work may be utilized for heating rooms by means of the pipe U, before described. By the arrangement of the pipes U and T and their valves U′ and T′ the operator is enabled to let the air of the exhaust escape out of doors or to use it for heating, as above described. The air is thus taken in a perfectly pure state and is very rapidly cooled, condensed, and heated, the power being proportionate to the effectiveness of the means used to accomplish these results. This is done by taking a quantity of air in its coolest and most condensed state and suddenly heating it to as high a degree of temperature as can be obtained and keeping it stored at this high degree of temperature until utilized for the work.

The reservoir Q may be made in several sections connected with each other, and located one above the other, if desired. The pipe J, instead of entering the heater G directly, may be first entered in a coil under the bottom G′—that is, the top of the furnace H.

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

1. In a hot-air engine, the combination, with the ordinary cylinder, piston, and chest, a hot-air reservoir connected with the chest, and a furnace for heating said reservoir, of an air-compressor having a cylinder separate from the engine-cylinder and a piston operated from said engine, an air-inlet in the compressor-cylinder, a discharge-channel leading from the said cylinder to the hot-air reservoir to supply the same with fresh air, and a second discharge-channel leading to the furnace.

2. A hot-air engine comprising an ordinary engine, a hot-air reservoir connected with the chest of the said engine, a heater located under the reservoir, a furnace for heating the said heater and reservoir, an air-compressor operated from the said engine and adapted to discharge into the said furnace and the said heater, and an air-cooler for cooling the air admitted to the said air-compressor, substantially as shown and described.

3. The combination, with the furnace, of a heater G, the bottom of which is formed by the furnace-top, a hot-air reservoir F, the bottom F^2 of which forms the top of the said heater G and terminates near one end thereof, and the metallic plates F′, extending from the furnace-top G′ up through the top of the heater G to the upper end of the reservoir, substantially as set forth.

4. In a hot-air engine, the combination, with an engine utilizing hot air as a motive power, of an exhaust-pipe leading from the said engine and provided with a valve, and a pipe connected with the said exhaust-pipe below its valve and leading into a room to be heated, substantially as shown and described.

5. In a hot-air engine, the combination, with an engine utilizing hot air as a motive power, of an exhaust-pipe leading from the said engine and provided with a valve, a pipe connected with the said exhaust-pipe below its valve and leading into a room to be heated, and a valve held in the said second-named pipe, substantially as shown and described.

6. In a hot-air engine, a furnace, a heater located above the said furnace, and an air-reservoir into which opens said heater, in combination with an air-compressor provided with the usual inlet and discharge valves, and pipes leading from the said discharge-valves into the ash-pit of the said furnace and into the said heater, substantially as shown and described.

7. In a hot-air engine, a furnace, a heater located above the said furnace, and an air-reservoir into which opens said heater, in combination with an air-compressor provided with the usual inlet and discharge valves, pipes leading from the said discharge-valves into the ash-pit of the said furnace and into the said heater, and a branch pipe connecting the said discharge-pipes with each other and provided with a valve, substantially as shown and described.

8. In a hot-air engine, a furnace, a heater located above the said furnace, and an air-reservoir into which opens said heater, in combination with an air-compressor provided with the usual inlet and discharge valves, pipes leading from the said discharge-valves into the ash-pit of the said furnace and into the said heater, a branch pipe connecting the said discharge-pipes with each other and provided with a valve, and a valve held in one of the said discharge-pipes, substantially as shown and described.

9. In a hot-air engine, the combination, with an air-compressor provided with the usual inlet-valves, of pipes opening into the said inlet-valves, a main pipe into which opens said two inlet-pipes, a receptacle into which opens said main pipe, said receptacle

being in communication with the outer air, and a cooler containing the said receptacle and adapted to receive a charge of cold water, substantially as shown and described.

10. In a hot-air engine, the combination, with an air-compressor provided with the usual inlet-valves, of pipes opening into the said inlet-valves, a main pipe into which open said two inlet-pipes, a receptacle into which opens said main pipe, said receptacle being in communication with the outer air, a cooler containing the said receptacle and adapted to receive a charge of cold water, and a valve held in one of the air-inlet pipes, substantially as shown and described.

11. In a hot-air engine, a furnace, a heater located directly above the said furnace, and an air-reservoir into which discharges said heater, in combination with an air-compressor discharging into the ash-pit of the said furnace and also discharging into the said heater, substantially as shown and described.

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