S. C. SALISBURY.

Method of Utilizing Hot-Air.

No. 204,094. Patented May 21, 1878.

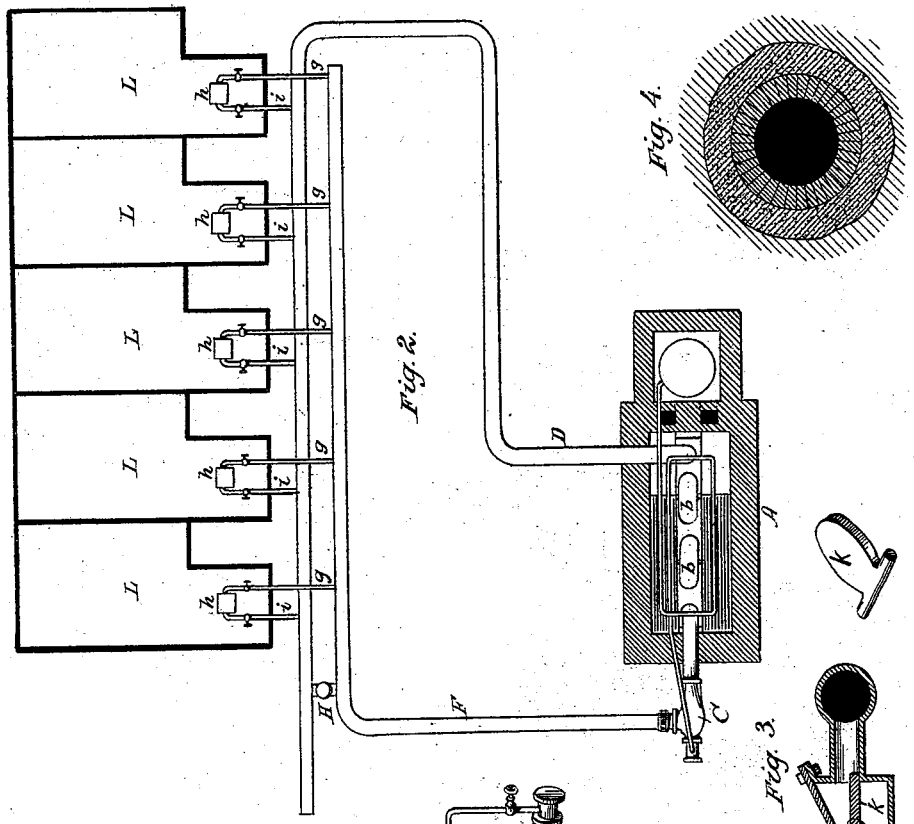

Fig. 2.

Fig. 4.

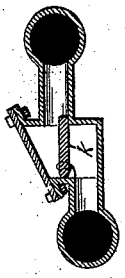

Fig. 3.

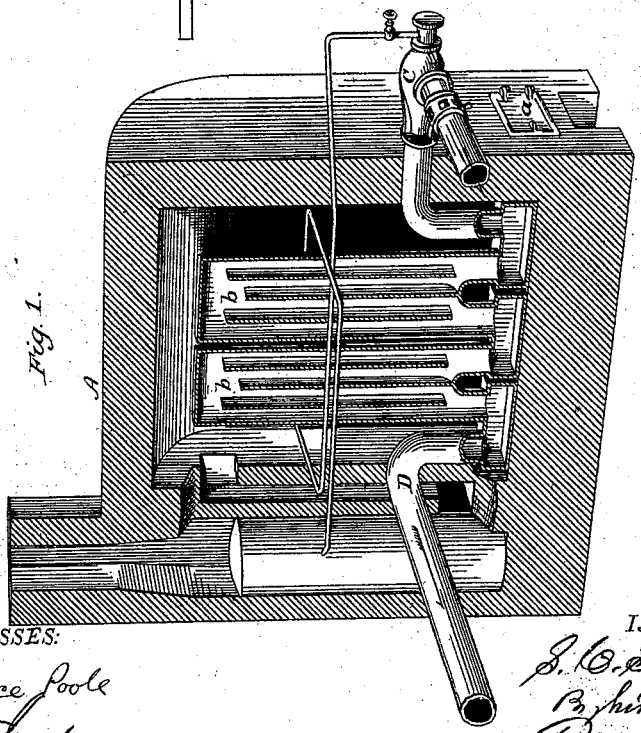

Fig. 1.

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SILAS C. SALISBURY, OF NEW YORK, N. Y.

IMPROVEMENT IN METHODS OF UTILIZING HOT AIR.

Specification forming part of Letters Patent No. **204,094**, dated May 21, 1878; application filed April 26, 1878.

To all whom it may concern:

Be it known that I, SILAS C. SALISBURY, of New York, in the county and State of New York, have invented a new and Improved Method of Utilizing Hot Air, of which the following is a specification:

Heretofore, when air has been employed as a vehicle for the conveyance of heat from the furnace to the subject to be acted on, the air-current so employed has generally been dissipated and lost in the surrounding atmosphere as soon as it had passed the point or object upon which it was designed or expected to act, and the heat held by it at the time of such dissipation is lost. Thus, as an illustration, at the lowest calculation, the hot air escaping at the top of the funnel of a steam-generator furnace carries with it seventy-five per cent. of the effective power of the fuel consumed, so that work represents not more than twenty-five per cent. and loss not less than seventy-five per cent. This vast per cent. is utterly wasted and lost. A certain portion of it consists of gaseous compounds, combustible and non-combustible; but with a well-constructed furnace by far the larger portion is simply air bearing with it the effective force of the fuel in the form of heat.

To supply the above-named loss of hot air through the funnel, cold air is being constantly drawn in at the draft, and the heat lost with the escaping air must be constantly replaced by a consumption of fuel in proportionate excess of the consumption due to the work performed.

I propose to remedy to a great extent this obvious and well-known loss by causing the hot air to move in a closed circuit, the same air constantly returning to the source of heat and only requiring the consumption of sufficient fuel to make good the loss of caloric expended in work and the slight loss by radiation.

I am aware that in blast-furnaces the waste gases have been collected at the top of the cupola and returned to the tuyeres, there to be burned. But this is not a closed circuit, because the necessity for the constant admission of fresh air to support combustion is the same as before. The waste gases are returned for the purpose of being themselves burned, and not for the purpose of aiding combustion or of being utilized as conveyers of heat from the furnace to some other point.

I am also aware that steam and hot water have been employed to convey heat from the generator to distant points and constantly return in a closed circuit; but in these cases entirely different and minor results are obtained.

I am also aware that a circulation of hot air in drying-kilns and in warmed apartments has been produced both by gravity and by machinery; but in those cases the circulation was in conduits not practically air-tight, the work was done in enlarged portions of the conduit, and not at separate points, and the temperature was comparatively low.

The effective difference between these practices and my present invention is sufficient to constitute the basis of an entirely independent invention.

By way of explanation, to clearly show the difference between my invention and the previous discoveries alluded to, as the law directs, I will mention that neither steam nor water possesses the capacity of air to receive and transmit heat. Steam is decomposed by high temperature, and its elements possess very different properties and capacities from a gaseous vapor.

For heating purposes steam is only available practically at a temperature ranging from 212° to 250°. At a higher temperature its expansive force and its decomposition render its use dangerous. Water cannot be employed at a temperature exceeding 212°, at which point it is converted into steam. These vehicles are therefore useless for the purposes of my invention, which demands a temperature ranging from 600° to 1000° Fahrenheit, as will more fully appear hereinafter. To render my meaning clear in this particular, any device whereby the heat of the blast is withdrawn therefrom and utilized I denominate a conversion of heat into work, as in a simple radiator for heating the surrounding air in a room, &c. My invention therefore consists in a hot-blast having a high temperature—say, of 800° or 1000° Fahrenheit—and caused to move in a circuit from heater to radiator, or place of work, and back to heater, said circuit

being closed, or nearly so, against the admission of fresh or cold air, so that when the hot air has passed the surface to be acted on it is returned to the heater, instead of being permitted to escape into the surrounding atmosphere, whereby it follows that it is only necessary to replace the heat lost in work and unpreventable radiation at each return to the heater, and the expenditure of fuel is the quantity necessary to so replace this expended heat to raise the temperature from, say, 700° to 800°, instead of a quantity sufficient to raise the same volume from, say, 70° to 800°. 800° may represent the effective temperature before work, and 700° the temperature afterward, showing an expenditure of 100°. In ordinary practice this residue of 700° will be lost, and must be constantly made good by the heating of cold air to the effective temperature.

It will appear evident that this invention is applicable to all purposes where the required temperature does not exceed that to which atmospheric air may be raised—say, for instance, 800° or 1000° Fahrenheit; and, without attempting to enumerate all such uses, I will only designate the heating of buildings, apartments, cooking, &c.

A description of a practicable method of applying my invention to these purposes will render the utility and method of the invention so plain that any further invention required in working it will be merely in minor details of the structure of appliances to be used in connection therewith.

Having now set forth the general features and scope of my invention, I will, for convenience, confine my particular description to methods of applying it to the purposes indicated above.

Figure 1 is a sectional perspective view of my apparatus for heating and controlling the blast. Fig. 2 is a diagram, showing my invention applied to heating houses, &c. Figs. 3 and 4 are details.

It will be understood that Figs. 1 and 2 represent merely a typical apparatus, and not a structure necessarily to be followed in any of its details.

A represents a hot-blast oven, which may be constructed in any approved manner; but a common structure is shown in the drawings, wherein *a* is the fire-box. *b* is a hot tortuous pipe, through which the blast is forced, and heated while in transit. These pipes *b* are constructed of refractory material, and when in full operation impart to the air passing through them a temperature ranging from, say, 700° to 1000° Fahrenheit. A blast of this character has never heretofore been employed, except in metallurgic furnaces for the purpose of intensifying the combustion of fuel by a copious supply of oxygen already heated to, or nearly to, the temperature of ignition, and, as above stated, none of the air once passing through the heater for such purpose is returned thereto again, so that the supply is constantly cold air.

The motor employed to move this air-current may be similar to those now employed, only adapted to withstand the high temperature to which it will be subjected. I make no claim herein to any method of forcing the blast; but the method I prefer to employ, because of its simplicity and efficiency, is steam-injection, which I have fully tested in connection with my hot-blast for metallurgic furnaces heretofore patented to me.

Fig. 2 represents, broadly, my plan of applying my hot-air circulation to domestic uses—that is, for heating buildings, apartments, cooking, &c.

L L represent, in plan, a row of buildings. A is the hot-blast oven, situated in a convenient location—say, in the court or interior space between the several rows composing a block or square of buildings. C is the injector, to force the blast through the flux-pipe D, to which it passes into the laterals *i*, and to the several buildings L, apartments, or places to be heated or supplied with heat. *h* represents the radiators or apparatus whereby the current of hot air is utilized, whether the same be for the purposes of warming merely, or for cooking, or for any one of the many domestic or industrial purposes which require heat.

After passing through the apparatus *h* the current of hot air returns by the pipe *g* to the reflux-pipe F, and again to the injector C and furnace A.

It will sometimes happen in a range of buildings supplied from the same main, as shown in Fig. 2, for instance, that a greater or lesser number of them will be out of use at some one moment of time, and in that event it seems evident the equilibrium of pressure would be disturbed. I therefore place between said pipes D and F a connecting pipe or passage, H, having within it an automatic pressure-valve, which will open when the pressure in pipe D exceeds the proper limit designed. For this purpose a simple weighted valve of some refractory material will answer efficiently. Without confining myself to the detail of an effective valve, I show in Fig. 3 an earthen or vitreous valve, *k*, mounted so as to effect my purpose.

The pipe D, when it extends along a street or court to serve a number of buildings, may be made of vitreous material, or otherwise, as preferred, and should be bedded in some efficient non-heat-conducting material. In Fig. 4 such a structure is shown. A good non-heat-conducting envelope is composed of plaster-of-paris and ashes.

It is not necessary to the object of this patent that I should give any detailed description of the apparatus to be employed in the various domestic or industrial uses alluded to above, as it will be understood no special structure is aimed at in this patent.

It is to be understood that I do not propose in this patent to cover specifically any special devices, either for heating, propelling, or utilizing the hot air; but to direct it more espe-

cially to the system whereby the various apartments of a house, or the various houses in a block, may be served with hot air from a central source of the same, much the same as gas is now served, and under the same easy control.

I propose to take separate patents for the various methods and apparatus required or desirable in employing the described hot-blast. I also propose to ask for individual applications, such as the generation of steam, &c.

Having described my invention, what I claim as new is—

1. The process, substantially as herein described, for using a blast of hot air at high temperature, as set forth, substantially in a closed circuit, as set forth, whereby said hot air is conducted to the point of work and returned to the heater in a constantly-recurring succession, as and to the effect set forth.

2. A blowing apparatus, a blast-heater, separate flux and reflux pipes or ducts, combined with a system of connecting-pipes, substantially as shown in Fig. 2, whereby the hot-blast is conveyed to the flux-pipe and transmitted therefrom to the reflux-pipe, for the purpose of distributing said hot-blast to a large number of intermediate points.

3. A blowing apparatus, a blast-heater, separate flux and reflux pipes, connected by lateral pipes *i* and *g* with interposed apparatus *h*, for utilizing the heat.

4. A blowing apparatus, a blast-heater, separate flux and reflux pipes, connected by lateral pipes *i* and *g*, and interposed apparatus *h*, combined with an equalizing-valve, H, substantially as set forth.

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Witnesses:
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