No. 111,691. PATENTED FEB. 7, 1871.

C. W. SIEMENS, E. A. COWPER & C. COCHRANE.

HOT BLAST STOVE FOR HEATING AIR, STEAM, &c.

2 SHEETS—SHEET 1.

(2 S

Fig 1

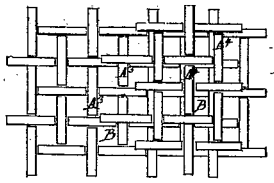
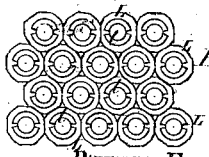


Fig 7



PATENTED FEB 7 1871

Fig 2

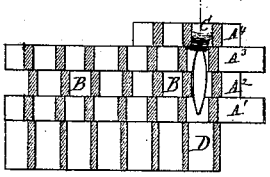


Fig 8

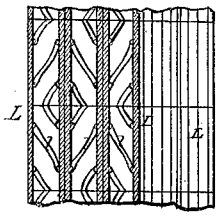


Fig 9

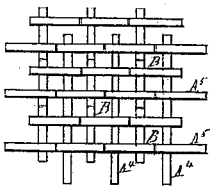


Fig 5.

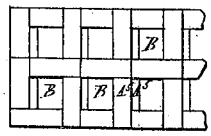


Fig 10.

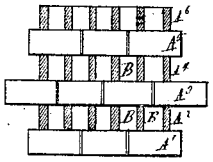


Fig 6

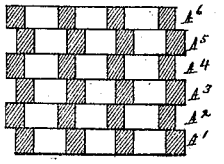
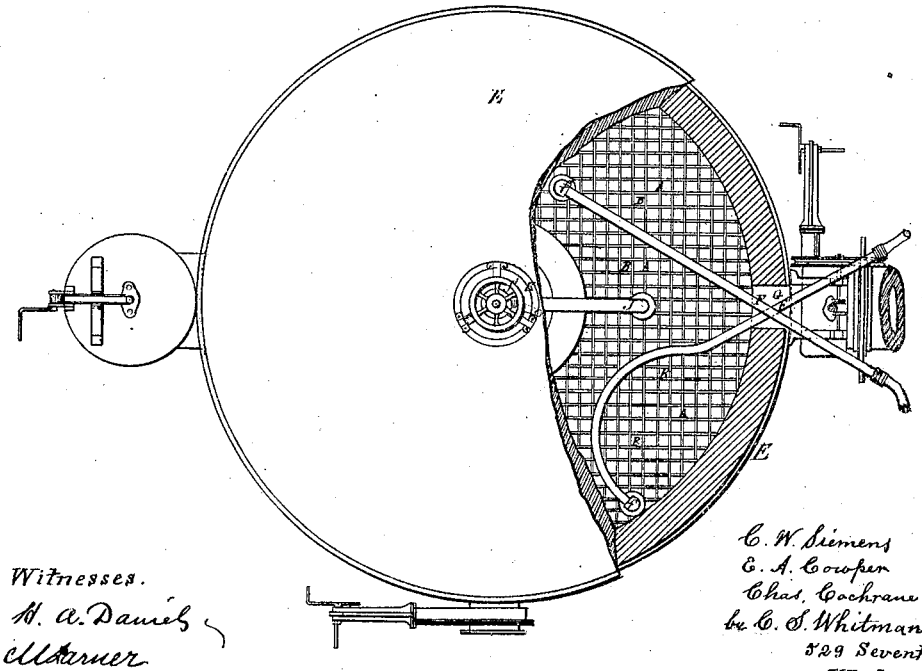


Fig 4



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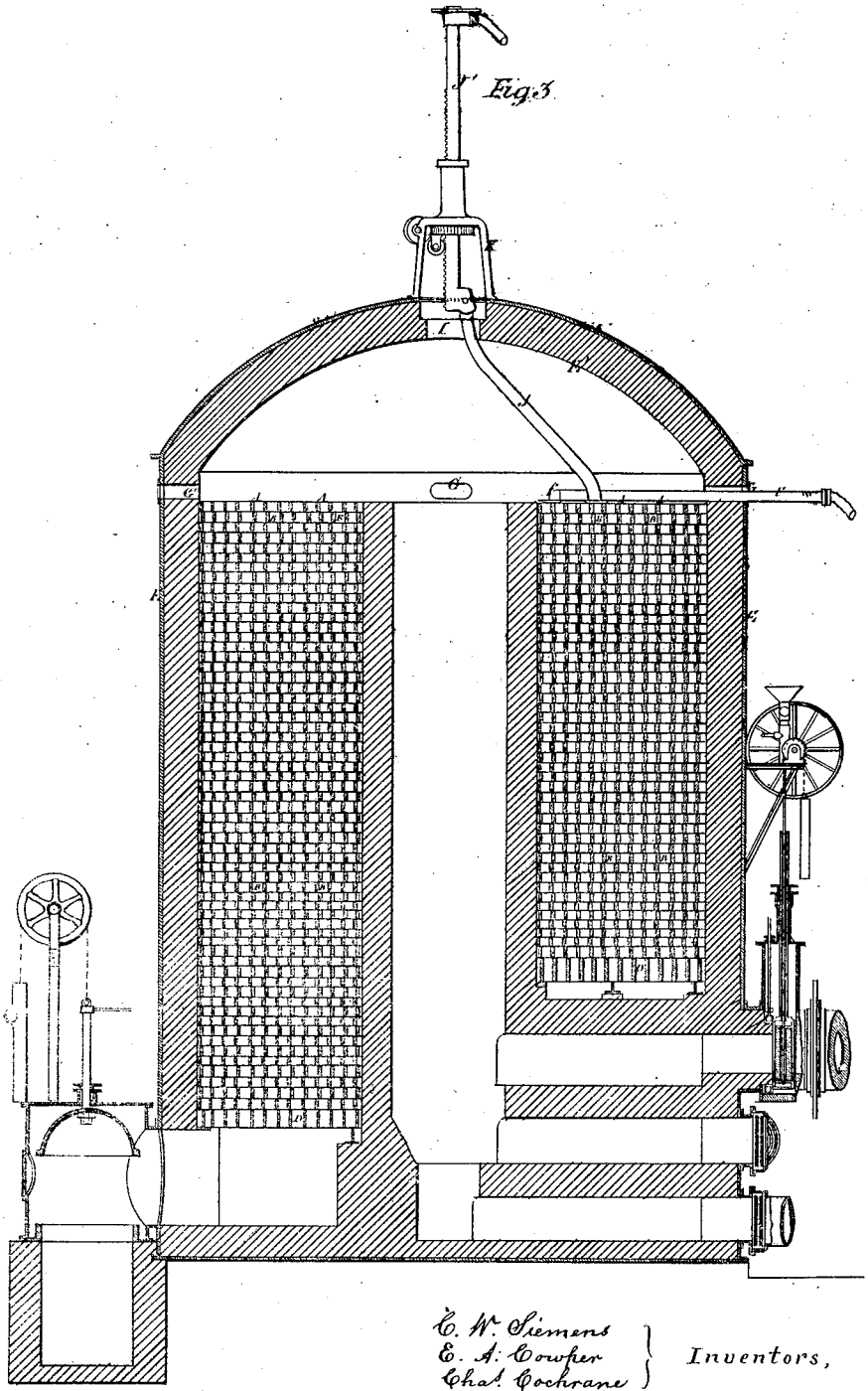
HOT BLAST STOVE FOR HEATING AIR, STEAM, &c.

2 SHEETS—SHEET 2.

Fig. 3.



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UNITED STATES PATENT OFFICE.

CHARLES WILLIAM SIEMENS AND EDWARD ALFRED COWPER, OF WESTMINSTER, AND CHARLES COCHRANE, OF THE ELLOWES UPPER GORNAL, ENGLAND; SAID SIEMENS AND COCHRANE ASSIGN THEIR RIGHT TO SAID COWPER.

IMPROVEMENT IN HOT-BLAST STOVES FOR HEATING AIR, STEAM, &c.

Specification forming part of Letters Patent No. **111,691**, dated February 7, 1871.

To all whom it may concern:

Be it known that we, CHARLES WILLIAM SIEMENS, of No. 3 Great George street, Westminster, in the county of Middlesex, England, and EDWARD ALFRED COWPER, of No. 6 Great George street aforesaid, and CHARLES COCHRANE, of The Ellowes Upper Gornal, in the county of Stafford, England, have invented an Improved Regenerative Hot-Blast Stove for Heating Air, Steam, and other Gases; and do hereby declare that the following description, taken in connection with the accompanying drawing, hereinafter referred to, forms a full and exact specification of the same, wherein we have set forth the nature and principles of our said improvement, by which our invention may be distinguished from others of a similar class, together with such parts as we claim and desire to secure by Letters Patent—that is to say:

It has hitherto been found, in employing regenerative hot-blast stoves as constructed according to E. A. Cowper's English patent, No. 1,404 of 1857, that when waste gases from blast-furnaces are used therewith without previous purification, the dust passing into the stoves with such gases is deposited in the checkered work inside the regenerators, and thus becomes very detrimental to the perfect action of the stoves; and we have found that the arrangements of fire-bricks and perforated tiles or blocks forming the checkered work, as shown and described in the above-named specification, and hitherto employed in the said hot-blast stoves, do not admit of being effectually cleaned out by a brush or cleaning-instrument, as there is not sufficient room to pass a brush or cleaning-instrument through the perforations in the perforated tiles or blocks, even without taking into account the slight irregularities that always occur in brickwork, or the fact of the tiles or blocks moving somewhat relatively to each other from expansion and contraction by heat; but even had it been possible to do so, the extreme amount of labor caused by separately manipulating twenty-one to forty-eight holes in every perforated tile or block filling the large regenerators required for hot-blast stoves would have rendered any such mode of cleaning entirely abortive and uneconomical, and it has therefore been found in practice absolutely necessary in cleaning out a stove to take out the whole of the fire-bricks or perforated tiles or blocks forming the checkered work, thereby entailing very considerable expense and great delay.

Now, our invention has for its object so to construct the checkered work or filling-in of the stoves that while the current of air or gas passing through the same is effectually broken up or disturbed and brought into contact with extended heated or heat-absorbing surfaces, yet the passages of the filling-in are so formed that a brush or cleaning-instrument can readily be passed down the same for effecually cleaning them from the deposit.

Such filling-in can be constructed in a great variety of ways for the purposes of this invention. Thus in one arrangement it consists of vertical continuous passages or flues of a circular, square, or polygonal transverse section, on the side surfaces of which are formed either helical, inclined, vertical, or horizontal projecting ribs or fillets, against which the current of air or gas, in passing up or down, is caused to impinge, whereby it is disturbed or turned over, so as to bring the central portion of the current to the outside, such projections still leaving ample room to pass the rod of the brush or cleaning-instrument through.

When horizontal or somewhat inclined projections are used, these may be arranged either alternately on opposite sides, so as to form more or less a zigzag passage, or they may be made opposite each other, so as to produce alternate enlargements and contractions of the passages.

When helical projections are used these may be in lengths, turning alternately right-handed and left-handed; or, in place of such helical and other projections, the entire passage may be made of a helical or twisted or zigzag form, or with alternate enlargements and contractions, always so arranged, however, that a central straight passage shall be left for the rod or suspending-cord of the cleaning brush or instrument.

Again, the filling-in may be built up of

superposed layers of bars or slabs, arranged to cross each other at right angles, or at any other angle, but so that the bars or slabs of the several layers lying in the same direction are not "placed over the spaces between them," or made to break joint, as heretofore, and as described in the before-mentioned specification, but are arranged vertically one above the other, so as to leave vertical spaces passing right through all the layers, through which the brush or cleaning-instrument may be passed; or, the bars or slabs may be so arranged as to leave slanting or inclined passages in place of vertical ones, for passing the brush or cleaning-instrument down.

In some cases, when it is wished to reduce the friction of the air through the stoves to a minimum, and it is therefore not considered desirable to obstruct the air very much by the introduction of considerable projections into straight passages, we purposely build the filling-in or brick-work so as to produce rough surfaces sufficient to cause the requisite disturbance in the air; but in such cases we provide ample room in the passages for large and efficient brushes or cleaning-instruments being used, so that the surfaces may be kept particularly clean, in order to cause the communication of the heat to take place with sufficient rapidity.

Our invention consists, furthermore, in employing, in place of or in conjunction with a brush or other cleaning-instrument for cleaning out the air-passages through the filling-in, a blast pipe or pipes for air or steam, or both, so arranged as to be applicable for blowing through the several passages one after the other, or through several at once, so that the energy of the blast may not be lost over the whole area of the filling-in, but may be concentrated as much as necessary to remove dust or deposit.

One pipe arrangement suitable for the purpose consists in a vertical pipe and stuffing-box at the top of the stove, and having an arm or arms attached to its lower end, carrying blast jets or nozzles to blow down the passages, the whole being rotated from the top after its introduction into the top part of the stove through the man-hole.

In order to vary the radius at which the jets act, the arms are provided with elbow-pipes that can open or close, so as to increase or diminish the distance from the center; or the arm or arms are caused to slide with telescope-joints in or out.

The apparatus may be put together by introducing the arm or arms at a small door at the side of the stove and screwing them into the vertical pipe, or it into them; also, flexible pipes, or pipes with joints in them, are to be used in the bottom part of the stove for cleaning, and the steam or air valve may be arranged to be opened very suddenly, so as to give sudden puffs of air or steam.

In place of or in addition to the above-named pipes for blowing out dust, other pipes are introduced, when necessary, through holes in the top of the stove, and are thrust down as far as may be necessary in order to remove dust, there being provided openings or jets in the sides of such pipes, so that on a blast of air or steam, or both, being applied through the pipes, it may take effect at the level at which the jet or jets happen to be, the pipes being raised and lowered and turned round as necessary; or they may be thrust down each passage separately to blow the dust out, in which case they can best be manipulated by a man in the stove, the air or steam being supplied through a flexible pipe.

Having thus set forth the nature of our invention, we will now proceed more particularly to describe the manner of performing the same, for which purpose we shall refer to the accompanying drawing, which serves to show some of the various arrangements by which our invention may be carried into effect.

Figures 1 and 2 on Sheet I show, respectively, a plan and vertical section of a very convenient and effective mode of constructing the filling-in of the stoves according to our present invention. It consists of a number of superposed layers of fire bricks or slabs, A^1 A^2 A^3, set on edge, and so arranged as to form in each layer a series of cells or boxes, each such cell or box being closed in on all four sides, while the cells of the one layer, A^2, though situated immediately over those of the layer beneath it, A^1, are shifted somewhat in a diagonal direction, so as to cause two sides of the cells of the lower layer to project beyond the same sides of the upper cells, while the two opposite sides of the upper cells are made to project beyond the same sides of the lower cells. Thus a series of continuous separate zigzag passages, B B, are formed, which cause an effectual disturbance or breaking up of the current of air or gas passing through them sufficient to bring every portion of such current in contact with the extended heating or heat-absorbing surfaces, while at the same time a sufficiently clear vertical space is left right through the passages to allow of an efficient brush, C, or blast of steam or air, being passed through them for removal of the dust deposited therein by the blast-furnace gases.

It will be seen that each brick or slab is held securely in position between the two ends of the adjacent bricks, so that when once placed in position there is no possibility of any derangement of the layers occurring.

The lowest layer, A^1, is made to rest upon an iron grid, D, forming cells corresponding in size and position with the cells of the layers, but also shifted somewhat to one side of these.

Fig. 3, Sheet I, and Fig. 4, Sheet II, show, respectively, a vertical section and a part sectional plan of a stove, E, to a smaller scale, in which the gases in combustion pass up into the chamber E^1 through a central shaft or passage, and then down through the passages in the filling-in, so as to heat the brick-work of which they are formed. The blast of air, steam,

or gas to be heated passes up through the passages of the filling-in after the brick-work has been heated and the gas for combustion has been shut off. Such blast then passes down the central shaft or passage to the outlet hot-blast valve.

The stove, as in the original arrangement patented by E. A. Cowper, as aforesaid, is inclosed in an air-tight wrought or cast iron casing, and is provided with valves to the inlet and outlet passages, as indicated. In these figures the filling-in is arranged as just described, and they show arrangements of pipes for the introduction of jets of steam or air into the passages for clearing out the dust.

Such pipes may be introduced, as at F F′, through side apertures, G G, ordinarily closed with a plate, the ends *f* of the pipes being bent down, so as to deliver the blast vertically into the passages. They are moved about by the operator, so as to bring the nozzle of the pipe successively over each passage, to facilitate which motion the nozzle of the pipe is provided with a rounded surface, as shown. Four such side apertures would be found sufficient to gain access to all the passages of the stove, and for conveniently reaching those passages, situated immediately against the sides of the stove, curved pipes F′ may be employed with advantage; or such steam or air pipes may be introduced through a central aperture, I, in the top of the stove, as at J, for which purpose a vertical pipe, J′, into the upper end of which the steam or air blast is introduced, is connected to the pipe J by an elbow-joint, and is carried by a frame, K, in which it is capable of being both raised and lowered and made to revolve by suitable gearing, whereby the nozzle of the pipe may be moved both in a radial direction to and from the center of the stove, and in a circular direction, so as to bring it over each of the passages in succession.

Another arrangement of cleaning-pipes consists of a vertical central pipe capable of turning, and connected to a horizontal pipe, provided either with a sliding telescopic pipe or an elbow-pipe, so that it may be altered in radius to blow down every passage.

Pipes may be applied from below to blow up the passages, if preferred, and this can be conveniently done by a man entering the space below the filling-in, as such space is generally cool, and can always be quickly cooled down by cold blast. In such case there is a guard or screen, like an umbrella, fixed to the pipe to keep the dust from falling on the man.

In some cases it may be convenient to perform the blowing and brushing operations simultaneously, for which purpose the end of the blast-pipe that is passed down the passages may be provided with a brushing or scraping surface.

Figs. 5 and 6, Sheet I, show, respectively, a plan and vertical section of another arrangement of the filling-in. Here, as in the first arrangement, separate continuous passages B B are formed by superposed cellular layers of fire-bricks A^1 A^2 A^3; but in place of each layer being shifted diagonally over the one below, they are only shifted to one side of each other, so as to form alternate projections on two sides, while the other two sides of the passage have an unbroken surface all the way through, as shown in plan.

Figs. 7 and 8, Sheet I, show a sectional plan and a vertical section of an arrangement in which the separate continuous passages are formed of lengths of fire-brick pipes or tubes L L, each length having helical projections *l l*, running in a contrary direction to those of the lengths situated above and below it, so that any portion of the air or gas passing up or down in a helical direction along such projections of the one length of pipe is made to travel in the contrary direction in passing against the projections of the next length, whereby the current of air or gas will be effectually disturbed, so as to bring all portions thereof into contact with the surfaces of the passages.

The cleaning out of these pipes may be very effectually performed by the brush, by causing the same, in its descent or ascent through the central space, to turn in a direction corresponding to that of the helical projections as it passes through the successive lengths of pipes.

The before-described passages may be made to act efficiently if provided with only slight irregular projections or roughnesses, or even if formed without either projections or roughnesses, as it must be borne in mind that owing to the large collective area afforded by all the passages of the filling-in, as compared with the area of the inlet-pipe, the air or gas ascends or descends through them at such a slow speed that a most perfect stratification of the air or gas, according to different temperatures, is attained, effectually preventing any rushing up of a central column of unequally-heated air or gas, the friction of the air or gas while moving at such a slow speed against even perfectly smooth surfaces being sufficient to disturb the current, so as to bring all portions thereof successively in contact with the sides of the passages.

Figs. 9 and 10 show, respectively, a plan and vertical section of an arrangement in which the filling-in is built up of superposed layers of fire-bricks, bars, or slabs, A^1 A^2 A^3, arranged to cross each other, but so that the bricks of the several layers running in the same direction are arranged vertically over each other, and not made to break joints, as heretofore, whereby vertical spaces B B are left passing right through all the layers, through which a brush or blast of air or steam may be passed. As, however, in this arrangement no separate inclosed passages are formed, the use of a blast of air or steam for cleaning purposes would not be so advantageous as in the previous arrangements.

It will be readily understood that by the facility afforded by our present invention for frequently clearing the passages of regenerative hot-blast stoves from deposit, we are enabled to maintain more effective heating-surfaces in the stoves than heretofore, and therefore the temperatures of the blast attainable by our improved stoves will be higher, and consequently a greater saving of fuel in the blast-furnace attained.

It has, in fact, been proved by experiment that the raising of the temperature of the blast from 800° Fahrenheit up to about 1440° effects a saving of coke in the blast-furnace of about eight hundred-weight per ton of iron made, and this saving may, by the use of the present invention, be further increased, as a temperature of 1500° or more is easily attainable thereby.

Having thus described the nature of our invention, and in what manner the same is to be performed, we wish it to be understood that we do not limit ourselves to the precise arrangements for carrying the same into practice hereinbefore described with reference to the accompanying drawing, as these may be variously modified, and various forms of passages be adopted for the filling-in, as hereinbefore stated, without departing from the nature of our invention; also, we are aware that regenerative hot-blast stoves have been constructed with a vertical zigzag or serpentine passage, as described in the specification to Whitwell's patent, No. 66,543, and we do not, therefore, claim such an arrangement as part of our present invention; but

What we claim is—

1. Constructing the filling-in of regenerative hot-blast stoves of a large number of separate vertical or nearly vertical passages of sufficient size to allow of a brush or blast of air or steam being passed through them for the removal of deposit therefrom, while at the same time the passage so formed with extended surfaces effectually absorb and give out the heat from and to the gases and air passing through them, substantially as hereinbefore set forth.

2. Constructing the filling-in of regenerative hot-blast stoves of separate vertical or nearly vertical passages, so formed with projections, contractions, roughnesses, or equivalent contrivances, that while the currents of air or gas, in passing through the passages, are effectually disturbed and brought into contact with extended heated or heat-absorbing surfaces, yet these passages readily allow of a brush or other cleaning-instrument, or a blast of steam or air, being passed through them for removing the deposit, substantially as hereinbefore set forth.

3. Constructing such aforesaid separate vertical passages in the manner and of the various forms hereinbefore described with reference to the accompanying drawing, or in any manner substantially the same, for the purpose of effectually absorbing and giving out the heat from and to the currents of gas and air, and yet allowing of the passage of a brush or blast of steam or air through them for the removal of the deposit.

4. Constructing the filling-in of superposed layers of bars or slabs, so arranged as to leave vertical spaces passing right through all the layers, through which brushes or blasts of air or steam may be readily passed, substantially as described with reference to Figs. 9 and 10 of the drawing.

5. The employment of blasts or jets of air or steam, or both, for the removal of the deposit in the passages of regenerative hot-blast stoves, substantially as set forth.

6. The various before-described arrangements of blast-pipes for the introduction of jets of air or steam, for clearing out the deposit from regenerative hot-blast stoves.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 26th day of October, 1870.

C. WILLIAM SIEMENS.
EDWARD ALFRED COWPER.
CHARLES COCHRANE.

Witnesses to the signatures of Charles William Siemens and Edward Alfred Cowper:

JNO. A. HEAD,
C. C. MARTIN.

Witnesses to the signature of Charles Cochrane:

JNO. T. BELK,
Notary Public, Middlesborough, England.
GEO. COCHRANE,
Ironmaster, Middlesbro-on-Tees.