(No Model.) 2 Sheets—Sheet 1.

B. FORD & J. MONCUR.

REGENERATIVE HOT BLAST STOVE FOR BLAST FURNACES.

No. 294,314. Patented Feb. 26, 1884.

Fig. 1.

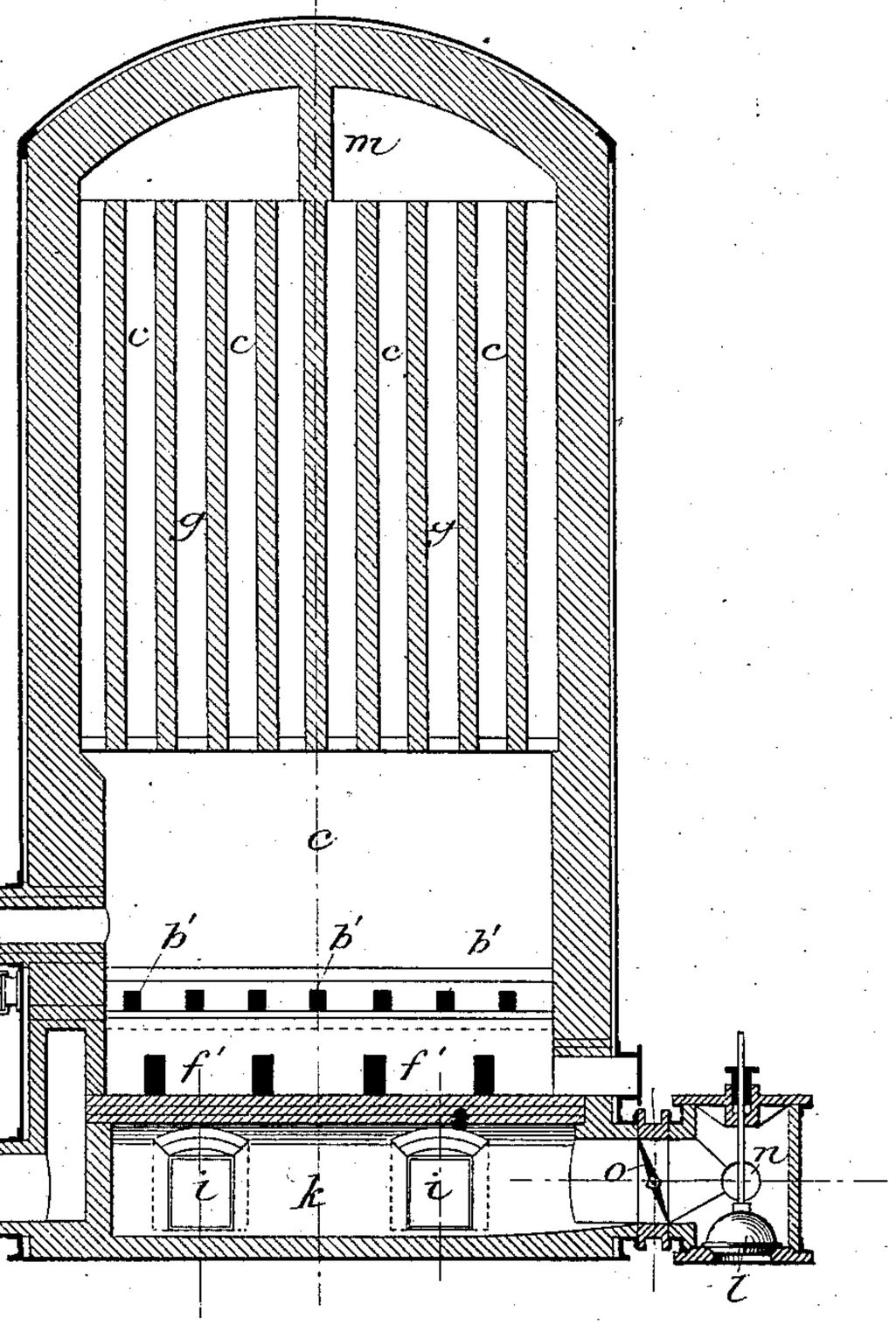


Fig. 5.

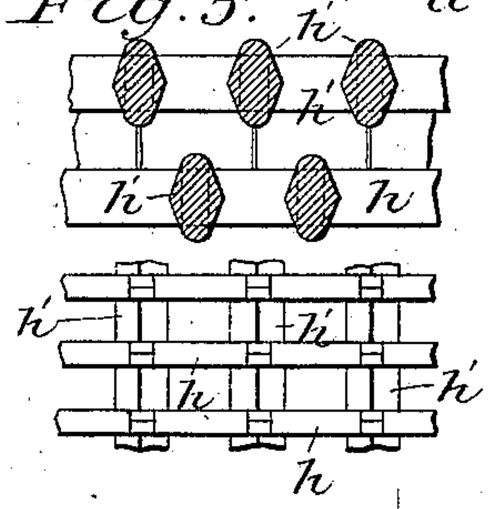
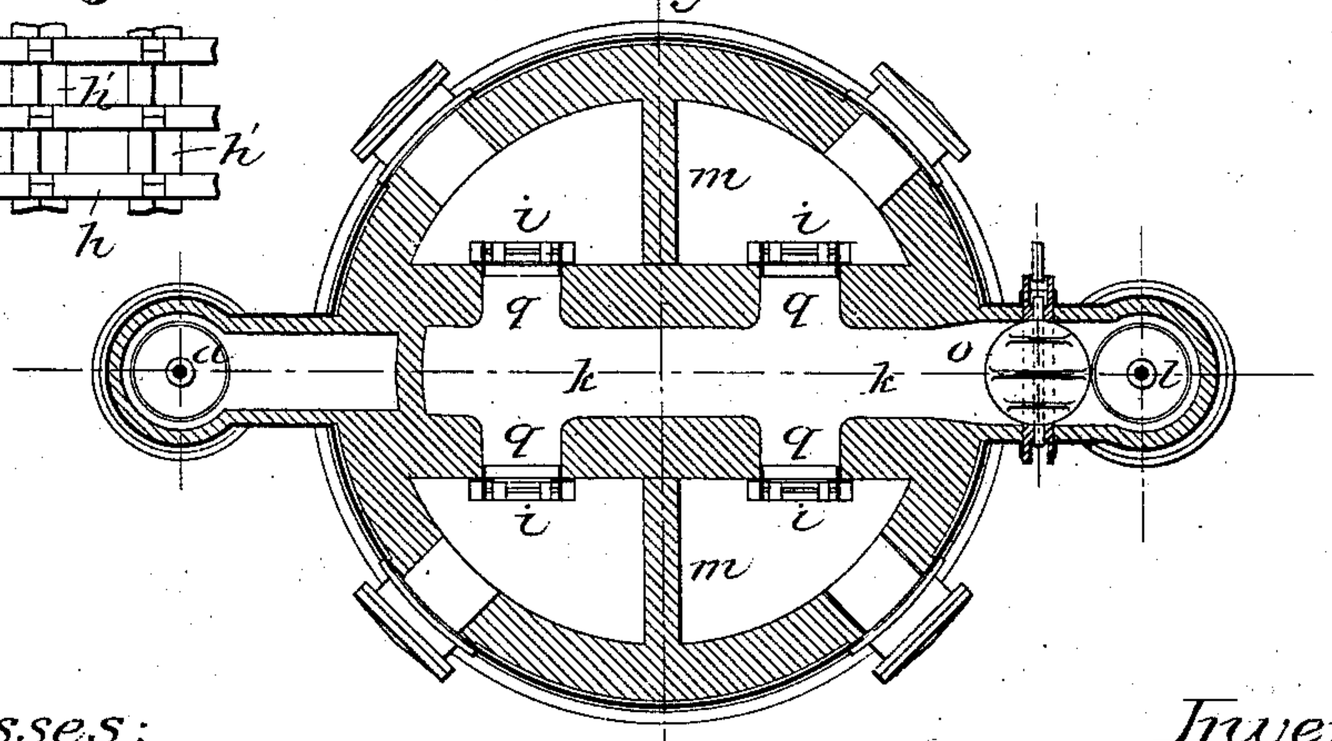


Fig. 3.



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their Atty's

(No Model.) 2 Sheets—Sheet 2.

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No. 294,314. Patented Feb. 26, 1884.

Fig. 2.

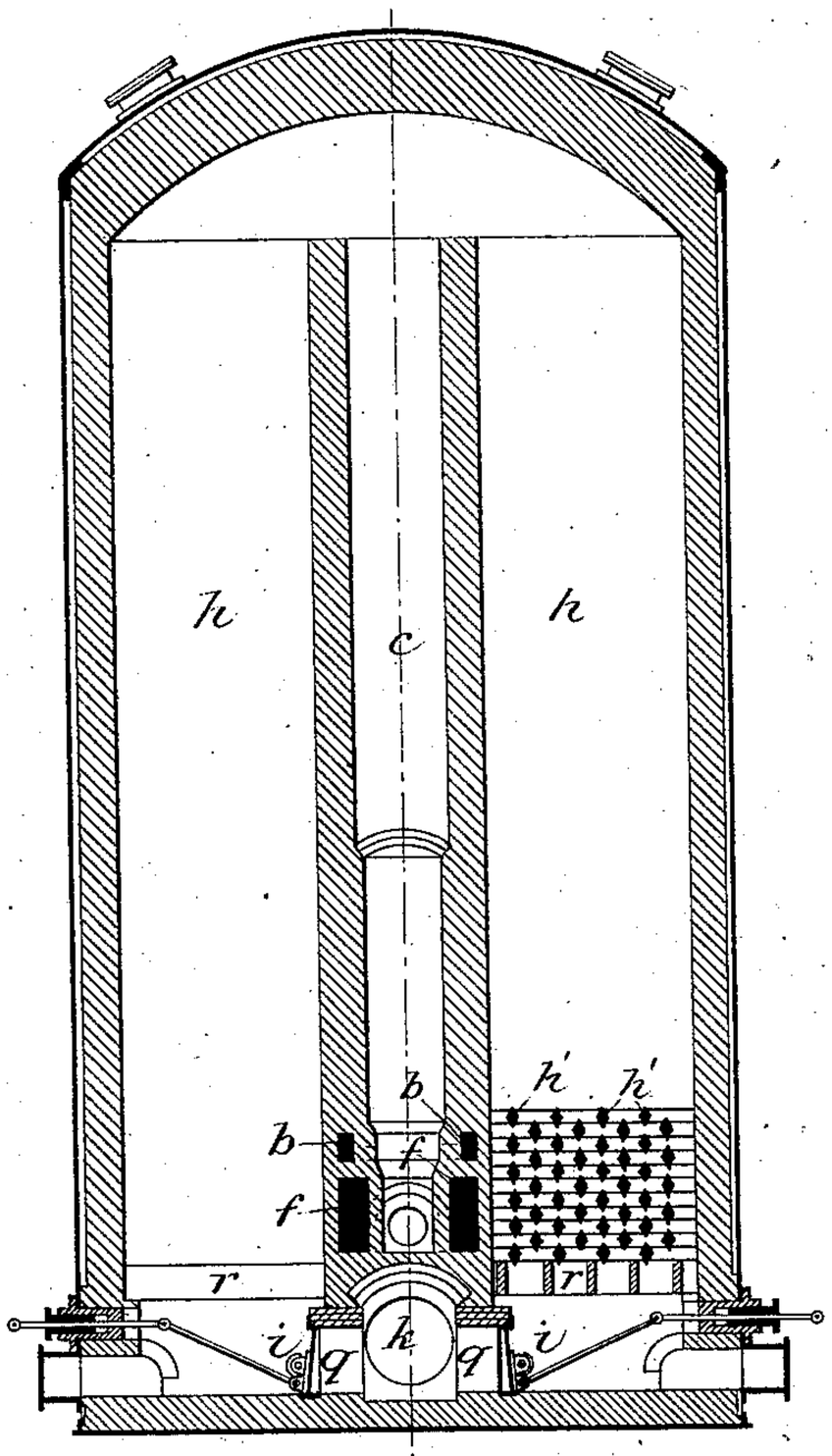
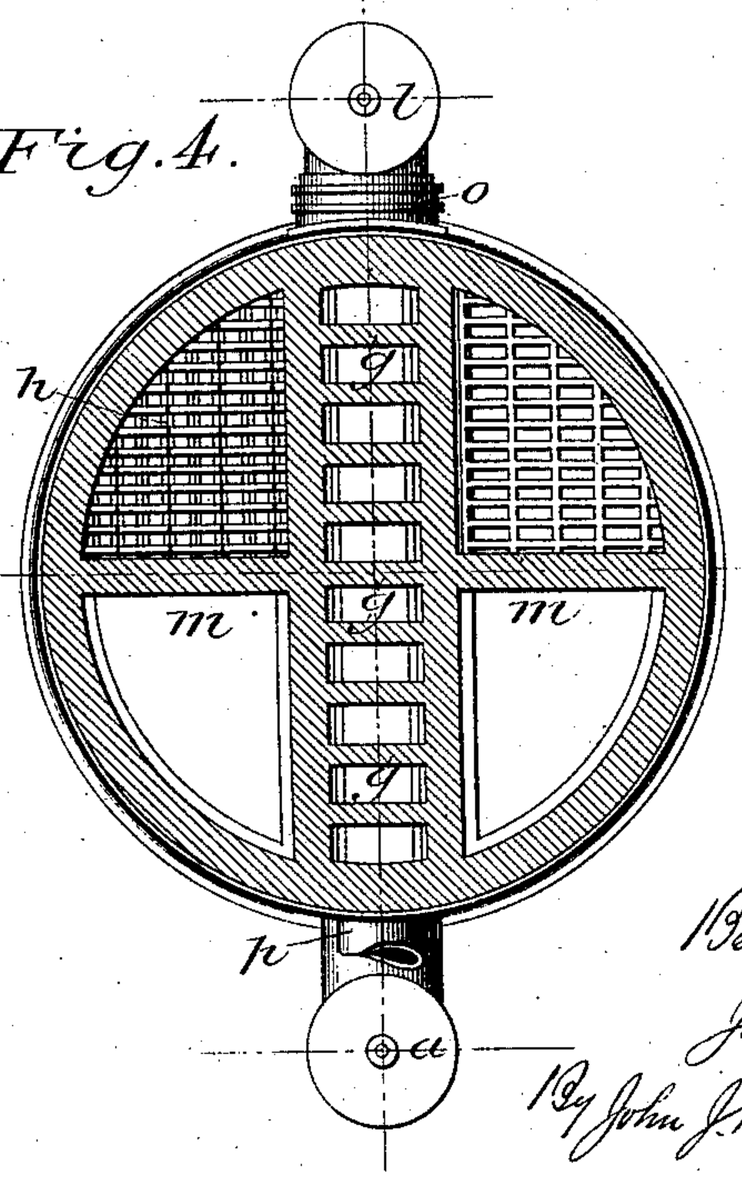


Fig. 4.



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UNITED STATES PATENT OFFICE.

BENJAMIN FORD, OF MIDDLESBROUGH-ON-TEES, AND JOHN MONCUR, OF DISTINGTON, ENGLAND.

REGENERATIVE HOT-BLAST STOVE FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 294,314, dated February 26, 1884.

Application filed March 10, 1883. (No model.) Patented in England August 15, 1882, No. 3,897; in France January 27, 1883, No. 141,105; in Belgium January 27, 1883, No. 43,914, and in Germany February 2, 1883, No. 5,072.

To all whom it may concern:

Be it known that we, BENJAMIN FORD, of Middlesbrough-on-Tees, England, and JOHN MONCUR, of Distington, England, subjects of the Queen of Great Britain, have invented certain new and useful Improvements in Regenerative Hot-Blast Stoves for Blast-Furnaces; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as 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 or figures of reference marked thereon, which form a part of this specification.

Our invention relates to regenerative or fire-brick stoves used for heating the blast for blast-furnaces.

It has for its objects novel methods of construction and arrangement by which, first, the temperature of the blast can be so regulated that it can be made to remain much longer nearly constant, and at whatever temperature may be required during the whole time that the stove is in operation, than in such stoves as heretofore ordinarily constructed and used; second, a better distribution is obtained of the flame and heating-currents over the area of the regenerative part of the stove; and, third, the heating-surfaces of the stove are kept clean.

The accompanying drawings are in illustration of our invention.

Figures 1 and 2 are vertical sections taken at right angles through a regenerative hot-blast stove, and Figs. 3 and 4 are horizontal sections at different heights through the same stove. Fig. 5 shows on a larger scale a modified form of the improved stays which we use between the parallel walls of the regenerative part of the stove.

The same letters of reference indicate the same parts in the several figures.

a is the valve through which the gas by which the stove is heated enters from the blast-furnace or other source of supply into horizontal flues *b b*, from which several apertures, *b' b' b'*, open into the lower part of the combustion-chamber *c*. Air is admitted by a valve at *d* through a passage into horizontal air-flues *f* which has openings *f' f'* into the combustion-chamber *c* immediately below the gas-apertures *b'*. The upper part of the combustion-chamber *c* is provided with staying-walls *g g*. The regenerator itself, *h*, is composed of parallel walls stayed by triangular or more or less lozenge-shaped stays *h'*, and supported by girders *e*. Internal valves, *i i*, which can be readily operated from outside the stove, as shown in Fig. 2, open into the central flue, *k*, which communicates with a chimney by a valve, *l*. The cold blast to be heated is admitted through a valve at *n*, and the heated blast passes to the furnace through a valve at *p*.

In Figs. 1, 2, 3, and 4 the regenerator is shown divided into two compartments by the central wall, *m*, and as the combustion-chamber *c* also divides the regenerator, the latter is thus divided vertically into four compartments. The lower part of each of these compartments can be made to communicate, as desired, with the flue *k* by apertures *q*, provided with the valves *i* where the temperature is lowest, and by these means each of the compartments or divisions of the regenerator can be put in communication with the flue *k* and chimney, or can be shut off, as desired.

In order to heat the stove, gas is admitted through the valve *a* to the flues *b*, and through the apertures *b'* into the combustion-chamber *c*, air also entering through the valve *d* into the flues *f*, and through the openings *f'*, to mix with the gas, the mixture being thus properly distributed over the combustion-chamber *c*, where it burns. The interior of the chamber and the staying-walls *g* become intensely heated, and the heated currents and products of combustion pass down and through the regenerator *h*, the parallel walls of which and stays *h'* present a large extent of surface, by which the greater part of the heat is absorbed. Each lozenge-shaped stay *h'* has a rectangular projection at each end, (shown in dotted lines,) and extending half the thickness of the bricks of the regenerator-walls. These projections, being the depth of the bricks, fit between their ends. The stays thus keep the walls of the regenerator *h* at the proper distance apart, while they are themselves supported and kept in position by their rectangular projecting ends fitting between the ends of

the bricks. The products of combustion then pass through the valves *i* to the flue *k*, and through the valve *l* to the chimney.

In order to heat and equalize the temperature of the blast in the stove heated in the manner just described, the gas-valve *a*, the air-valve at *d*, and chimney-valve *l* are closed, and cold blast is admitted through a valve at *n*, and, passing through the flue *k*, enters the lower part of the generator through the valves *i*, which can be opened or closed from outside, as already described. In its passage slowly up the regenerator, the blast is thoroughly diffused by coming in contact with the triangular or lozenge-shaped stays *h'*, and the parallel walls *h*, and absorbs the heat from the highly-heated surfaces. It then passes down the intensely-heated walls of the combustion-chamber *c*, and through a hot-blast valve at *p* to the blast-furnace. The blast in its passage having acquired the maximum temperature of the stove, this temperature will gradually decline, great irregularity in the working of the blast-furnace being thus caused; and in order that this irregularity may be remedied and regulated without requiring the use of three or more stoves to a furnace, we adopt the following novel method of operation, by which the blast can be made to pass through the valves *i* to one, two, three, or all the four compartments of the regenerator, as may be desired. Supposing that the stove has been heated to a maximum temperature, and that it is required to have a nearly equal temperature of the blast, though somewhat lower than the maximum heat of the stove, such temperature to continue equal for a considerably longer time than if the blast were passed through the whole of the stove at once, as in the ordinary manner, the desired equality of temperature can be obtained and regulated in different ways by the valves *i*. For instance, the blast may be blown through one or more of the compartments of the regenerator, the others being shut off by the valves *i*, and the cold blast being thus prevented from passing through them. These shut-off compartments would retain their heat, and as the temperature of those through which the blast is passing begins to fall then by gradually opening the other valves the blast would be re-enforced and supplemented by that made to pass through the hot compartments of the regenerator, and its temperature would continue for a considerable time nearly equal; or sometimes we blow the cold blast through, say, two quarters or divisions of the regenerator, and as soon as the temperature of the blast begins to fall we open another quarter or division, and gradually close one of the divisions first opened, thereby allowing more time for the blast to absorb the heat in its passage through this division. Then, to still further supplement the heat, we open the fourth or last quarter or division, and gradually close that first blown through. By means, therefore, of the internal valves, *i*, we maintain a practically equal temperature of blast from each stove during the whole time it is on blast.

In order to keep the heating-surfaces of the stove clean, it is necessary to remove a substance highly non-conducting of heat, which is deposited upon them during the combustion of the gas. When this deposit is newly formed, it is easily removed, being of a light powdery nature; but after it has been allowed to accumulate and has been subjected to the pressure of the blast in the stove, it adheres firmly, and can only be removed by scrapers or brushes. Attempts have heretofore been made to utilize the force of the contained air in the stove to expel this deposit; but by our novel method of constructing the regenerator and part of the combustion-chamber in two or more separate compartments, each communicating, when desired, by means of the internal valves, *i*, with a valve leading to a chimney or other external valve, we are enabled to cause the force of the contained air in the whole stove at blast-pressure to rush through the comparatively limited area of only one quarter or division of the stove, and in this way such contained air is made to rush through each division in turn, one at each change from blast to gas. In this way the dust or deposit is carried through the chimney-valve into the chimney-flue, or through any other suitable external valve to a proper receptacle, and the heating-surfaces of the stove are thus kept clean. And in order further to lessen the settlement of the dust or deposit referred to upon the stays between the parallel walls of the regenerator, we make these stays of such shape that they present no flat horizontal surface upon which the deposit may lodge; but we make them triangular or more or less lozenge-shaped in cross-section, as shown in Figs. 2 and 4, the walls being properly made to support them, as shown in Fig. 5.

We prefer to construct and arrange the internal valves, *i*, so that they can be instantaneously opened when required; or sometimes we place a separate external cleaning-valve, *o*, in the neck of the flue, so arranged that it can be instantaneously opened, and by opening any of the internal valves, *i*, we discharge the contained air, carrying with it the deposit which it is desired to remove, through the quarter or division of the stove with which the opened internal valve is in connection, and either through the valve *l* to the chimney-flue, or through any external valve into a suitable receptacle; or, instead of the separate cleaning-valve *o*, we sometimes use an external valve (capable of being rapidly opened) to each compartment of the regenerator; and in order to clean any compartment, we open its internal valve, *i*, and the external valve connected with it, the other internal valves, *i*, having been previously closed. By this means the contained air is compelled to pass down the particular compartment to which the opened external valve is connected.

The external valves described may be ar-

ranged to discharge into a flue connected with the chimney-flue or into other suitable receptacle.

We do not confine ourselves to the precise form and arrangement of the several parts of the apparatus as hereinbefore described and shown, which may be modified to suit varying circumstances—as, for instance, the combustion-chamber may be circular in plan and the regenerator divided into four compartments by four dividing-walls; nor do we claim, generally, the use of external valves for the purpose of cleaning regenerative hot-blast stoves; but

What we desire to claim is—

1. The combination, with the several compartments *h* into which the regenerator is divided, of the corresponding internal valves, *i*, and the flue *k*, substantially as and for the purposes described and shown.

2. In combination, the compartments *h*, valves *i*, combustion-chamber *c*, air-flues *f f*, openings *f' f'*, gas-flues *b b*, and openings *b' b'*, substantially as described and shown.

3. The combination of the separate compartments *h* of the regenerator, the internal valves, *i i*, flue *k*, and external valve or valves, *o*, for the purpose of removing and carrying away deposit from combustion, substantially as described and shown.

4. The triangular or lozenge-shaped stays *h'*, located between the walls of the regenerator *h*, substantially as described and shown.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

BENJAMIN FORD.
JOHN MONCUR.

Witnesses:
CH. GAUDIER,
JOHN E. VIPOND.