

No. 644,162.

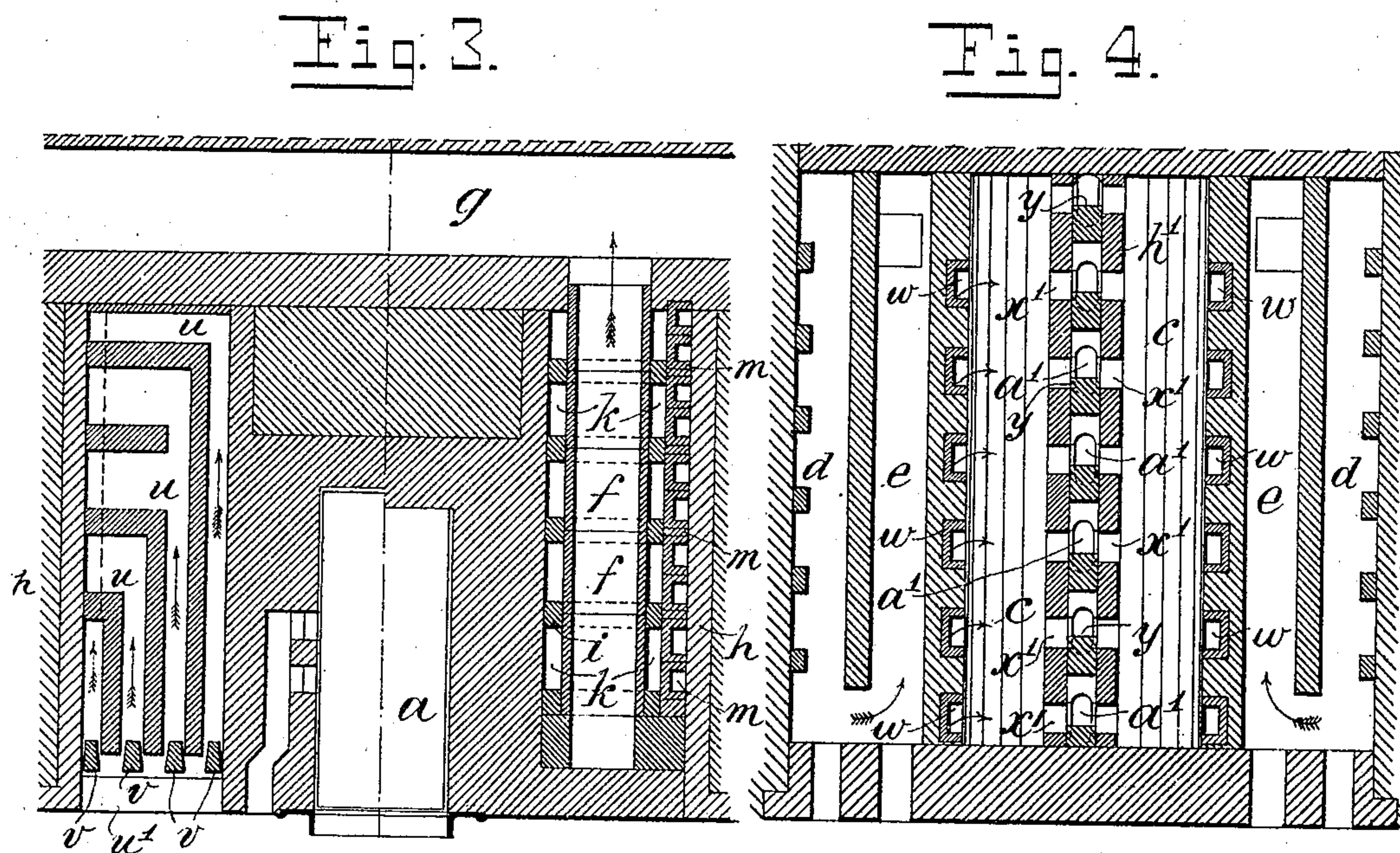
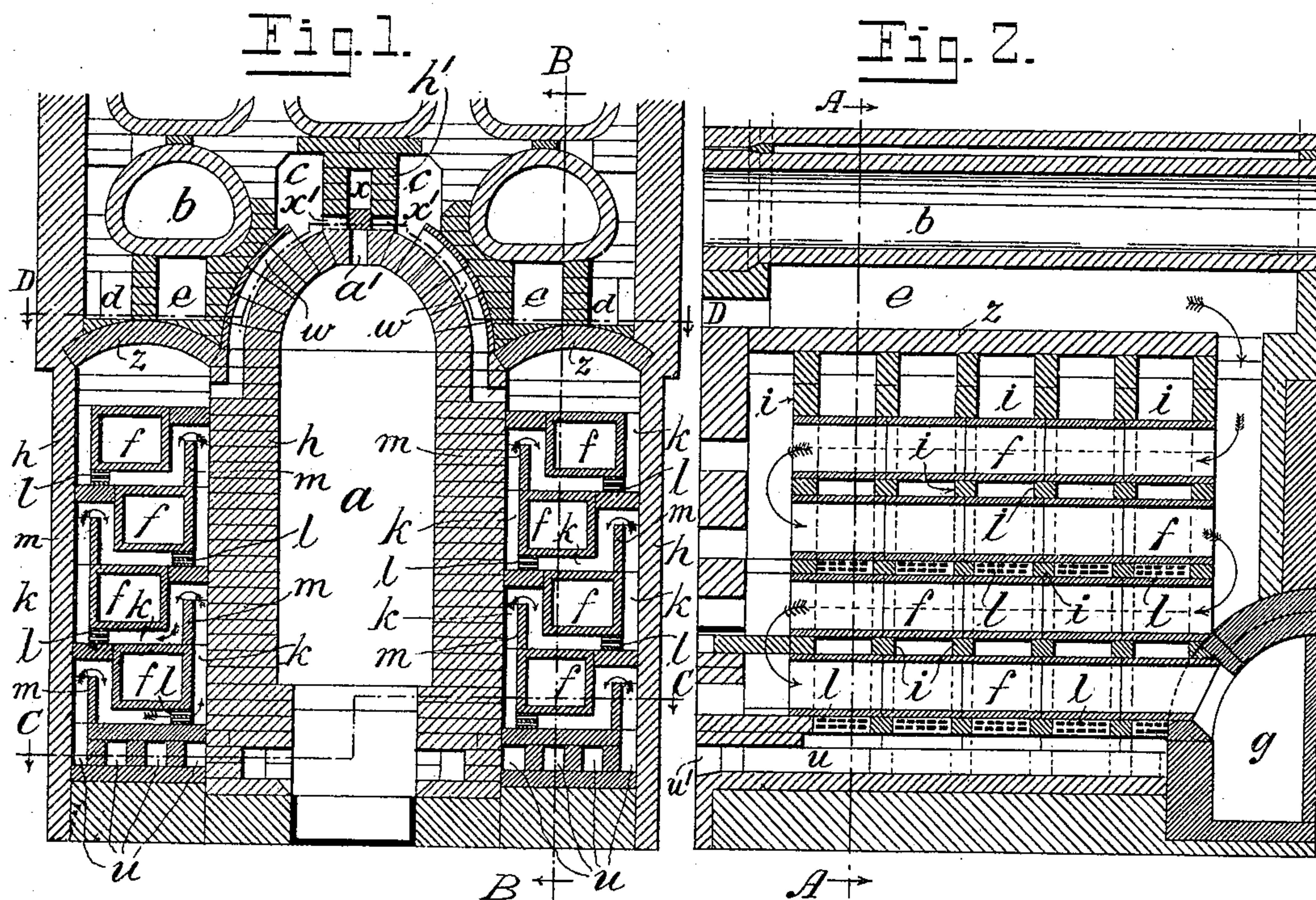
Patented Feb. 27, 1900.

J. A. DRAKE.
METALLURGICAL FURNACE.

(Application filed Oct. 13, 1899.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses.

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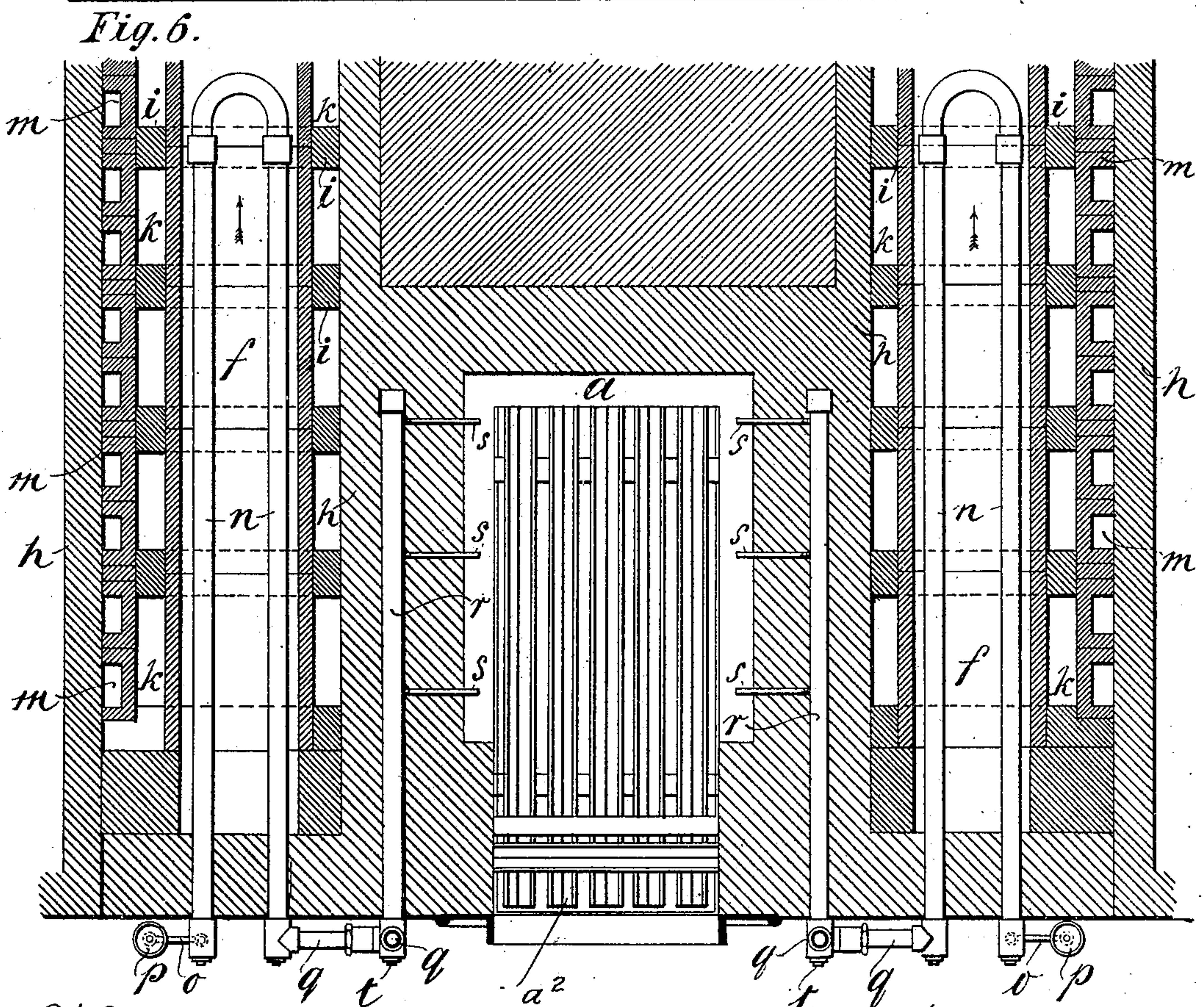
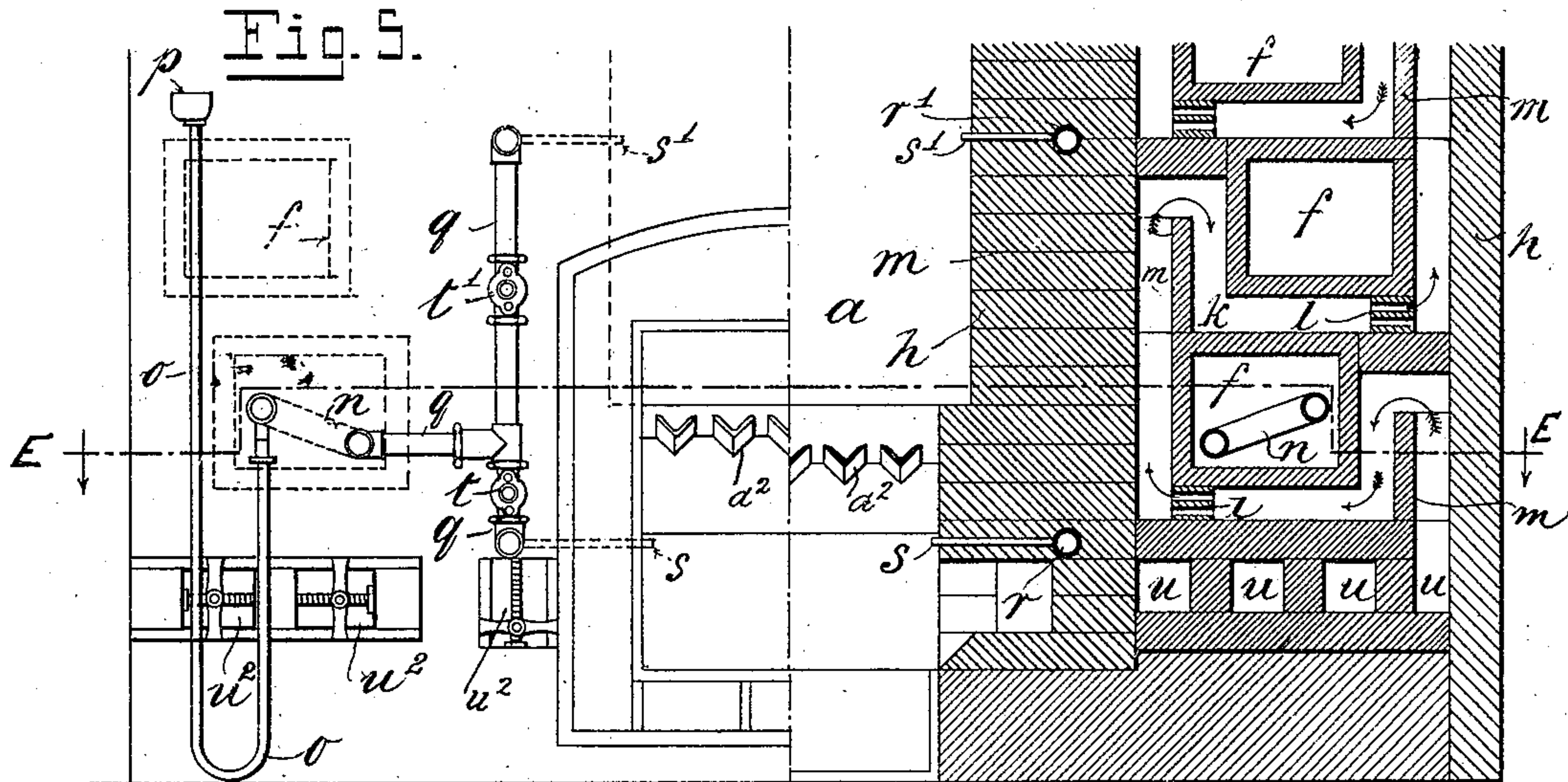
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(No Model.)

2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

JOHN ARMITAGE DRAKE, OF OVENDEN, ENGLAND.

METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 644,162, dated February 27, 1900.

Application filed October 13, 1899. Serial No. 733,524. (No model.)

To all whom it may concern:

Be it known that I, JOHN ARMITAGE DRAKE, a subject of the Queen of Great Britain, residing at Ovenden, near Halifax, in the county of York, England, have invented certain new and useful Improvements in Metallurgical or other Like Furnaces for Calcining, Reducing, Carbonizing, or other Analogous Purposes; and I 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.

This invention relates to metallurgical and other like furnaces and kilns for calcining, reducing, carbonizing, and other analogous purposes.

The object of the invention is to combine with generator or regenerator furnaces and producers new and novel forms of recuperators and means for governing and controlling the secondary air supply or supplies and furnace-gases, whereby the whole of the waste heat and gases from high-temperature kilns, ovens, stoves, and the like may be fully utilized in the heating of the secondary air-supplies and complete combustion of the furnace-gases and the secondary air-supplies insured.

To the aforesaid purpose my invention consists in the novel and peculiar arrangement and construction of parts of the furnace and recuperator, as hereinafter fully described.

In the accompanying drawings illustrating my invention, Figure 1 is a transverse sectional elevation, taken on line A A of Fig. 2, of a recuperator and producer embodying my improvements. Fig. 2 is a longitudinal sectional elevation taken on line B B of Fig. 1. Fig. 3 is a sectional plan view taken on line C C of Fig. 1. Fig. 4 is another sectional plan view taken on line D D of Fig. 1. Fig. 5 is an enlarged front elevation, partly in section, of the lower portion of the furnace or oven; and Fig. 6 is a sectional plan view taken on line E E of Fig. 5.

The same letters of reference indicate corresponding parts in all the figures.

Referring to the drawings, letter *a* represents the furnace or producer chamber provided with a grate *a*²; *b* the retorts, ovens, kilns, or the like, as the case may be, which are to

be heated thereby, and *c* the combustion chambers from which the products of combustion pass direct to and circulate around the ovens, muffles, or kilns in the ordinary way. After performing their work in heating the ovens *b* the waste gases or products of combustion pass by way of channels *d d* and *e e* to flues or passages *f*, which convey them downwardly in a zigzag course from back to front and front to back alternately in a direction lengthwise of the furnace, as indicated by the arrows, as many times as may be desired, and finally deliver them into the main flue or uptake *g* for discharge into the atmosphere.

The flues or passages *f* comprise or are formed of open-ended fire-clay tubes which are set one above the other at short distances apart and preferably clear at each side of the side walls of setting *h*. These tubes *f* are solid drawn or pressed to suitable shapes to suit the various operations for which the ovens, muffles, or kilns to which they are applied are required, and they are of convenient lengths to suit the length of traverse necessary to extract all the available remaining heat from the effluent gases escaping there-through to the atmosphere. *i* are transverse fire-brick walls covering the joints of the tubes *f* to prevent leakage resulting from the shrinkage or settling down of the foundation-work, so that it is not possible for the effluent gases to percolate into the air-flues or for the air to find its way into the flues or passage *f*, said walls also serving to support the tubes *f* rigidly in position in the setting. The spaces surrounding the tubes or effluent gases' flues *f* form the air-passages *k*, through which air passes in a transverse direction backward and forward from side to side between the tubes *f* and between such tubes and the side walls of setting *h* alternately from the bottom to the top of the recuperative chambers, as indicated by the arrows, and in its zigzag traverse is thus brought into intimate contact with approximately the whole surface area of the tubes *f*, so that the incoming air will on its way to the combustion-chambers absorb and take up the heat of the waste effluent gases passing downward through the tubes *f* to the uptake or main outlet-flue *g*. The inlet and outlet end of each tube or flue

f extend beyond the air-passages *k* at the front and rear end of the recuperators, and the effluent and waste gases therefore in their course downward to the main outlet-flue *g* completely envelop the air passing upward through the air-passages *k* and prevent any chilling of same by contact with an outer wall or surface radiating heat to the outside or exterior of the furnace.

l are tiles or thin bricks placed between the tubes *f* and having holes or perforations therein, through which the ascending air must pass in its course around the several tubes *f*, these perforations breaking up or finely dividing the air, so that no central column or core of cold air can pass into the combustion-chambers, as is the case when the air passes through the recuperative chambers in a volume or undivided state.

m are vertical channeled tiles or longitudinal plain tiles on edge for conducting the air over all the exposed surfaces of the tubes or effluent-gases' flues *f* by guiding it on leaving one tube *f* to the top of the next higher tube, whence it then descends to the bottom of the same, and after passing thereunder and in like manner up the opposite side is conducted by another channeled or plain tile to the top of the third tube *f*, this being repeated at each tube as the air ascends to the combustion-chambers.

z are covering-arches of fire-bricks or other fire-resisting substance carried by walls *h*. These arches *z* support the weight of the work above them, so that access can be readily had to the effluent-gases' tubes *f* or any of them for purposes of repair or renewal without having to disturb any portion of the oven or kiln proper.

Placed longitudinally in the lowest tube or effluent-gases' flue of each tier of tubes or flues *f* are coiled pipes *n*, into which water trickles from the outside of the furnace or oven by way of *U* pipes *o*, (see Figs. 5 and 6,) provided at their extremities with funnels or collectors *p* to receive the water. The water in its passage through the heated coil-pipes *n* is converted into steam which is conveyed through piping *q* to pipes *r* and *r'*, extending longitudinally into the setting *h* and each provided at intervals apart with open-ended tubes or nozzles *s*, projecting under the grate-bars or hearth of the furnace or producer and the tubes or nozzles *s'*, projecting into said furnace or producer chamber at a suitable elevation above the grate-bars. The steam supplied to the pipes *r* and *r'* issues from the nozzles *s* and *s'* to the under side of the grate-bars and into the producer *a* and further assists in the development of high temperature in the ovens or kilns above mentioned, and likewise reduces the temperature of the effluent or waste gases as much as possible before they escape to the chimney.

Either one or the other of the pipes *r* and *r'* can be shut off from the steam-supply by the valves *t* or *t'*.

The pipes *n* and their coacting nozzles, valves, &c., can be dispensed with, if desired, as shown in Figs. 1 to 4.

The foregoing briefly describes the construction and arrangement of recuperators of metallurgical generator or regenerator furnaces, to which this invention more particularly applies and with which it is combined to form part thereof.

For the purpose of governing and controlling the air admitted to the recuperative chambers according to my invention the brick walls *i* are made solid from side to side of the recuperative chambers, so as to divide the air spaces or passages *k* into several sections longitudinally, as shown at Fig. 2, such said sections having no communication one with the other, and therefore differing in this respect from all other constructions of recuperators. Leading to the lower or inlet ends of each section of air-passages *k* are air-admitting channels or conduits *u*, extending longitudinally from their respective air-passages to near the front of the furnace and terminating in a chamber or box *u'*, provided at the front with sliding doors or valves *u²* (see Fig. 5) for primarily controlling or regulating admission of atmospheric air to such chamber or box. In addition to such sliding doors or valves loose wedge-shaped blocks *v*, Fig. 3, are provided, which are adapted to be moved into or withdrawn from the mouths of the air-admitting channels or conduits *u*, and thereby contract or increase the area or space of same through which air can pass from the chamber or box *u'* into said channels. By adjusting the doors or valves over or away from the opening or openings into the chamber *u'*, and also, as a further governing or regulating factor, by moving the blocks *v* more or less into or from the mouths of the channels *u* the supply of air to the several divisions of the recuperator, and therefore to the combustion-chambers, can be controlled and governed to the greatest nicety to suit all requirements. The quantity of air admitted through the several sections of the air-passages *k* is also regulated and, if necessary, equalized. Consequently there is a regulated distribution of heated air to the combustion-chambers from front to back thereof to meet the producer or furnace gases and insure perfect combustion. Instead of using the movable blocks the channels or openings *u* may be continued to the front of the furnace and a separate sliding door or valve *u²* employed to control each said channel or conduit. The highly-heated air passes from the recuperative chambers or air-passages *k* to the combustion-chambers *c* through the flues or nostrils *w*.

In conjunction with the aforesaid method of and means for governing and controlling the admission and supply of secondary air I adopt means for governing and controlling the producer or furnace gases, such means consisting of a chamber *x*, formed in the sup-

porting-wall h' , built on the crown-key block of the arch of the furnace or producer chamber, into which chamber x all the producer or furnace gases pass from the producer-chamber a through openings a' and thence escape through lateral openings x' into the combustion-chambers c to meet the heated-air supplies. The width of chamber is made rather larger than the width of the openings a' leading thereto from the producer-chamber a in order to receive the bricks or blocks y of suitable size and shape, which lie flat upon the floor of said chamber x and are adapted to be moved over or away from the openings a' and x' , as required, to effectually check or retard at will the passage of the producer or furnace gases from the producer a to the combustion-chambers, and which is done in order to prevent local or unequal heating of the parts of said combustion-chamber.

I claim as my invention—

In a regenerative furnace, the combination,

with an outer casing, and a series of longitudinal heating-flues f arranged therein one above the other and forming a tortuous passage for the products of combustion; of a series of transverse imperforate walls i supporting the said flues and forming a series of cold-air passages having no communication with each other, tiles arranged in the said passages so that the cold air is conducted around each heating-flue, and a series of longitudinal air-inlet passages u arranged under the said flues f , each said cold-air passage being provided with a separate inlet-passage so that the air passing through each can be regulated separately to secure uniformity of temperature, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN ARMITAGE DRAKE.

Witnesses:

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LEONARD CROSSLEY.