No. 648,359. Patented Apr. 24, 1900.

J. P. MOULTON.

FURNACE.

(Application filed Aug. 23, 1897.)

(No Model.) 5 Sheets—Sheet 1.

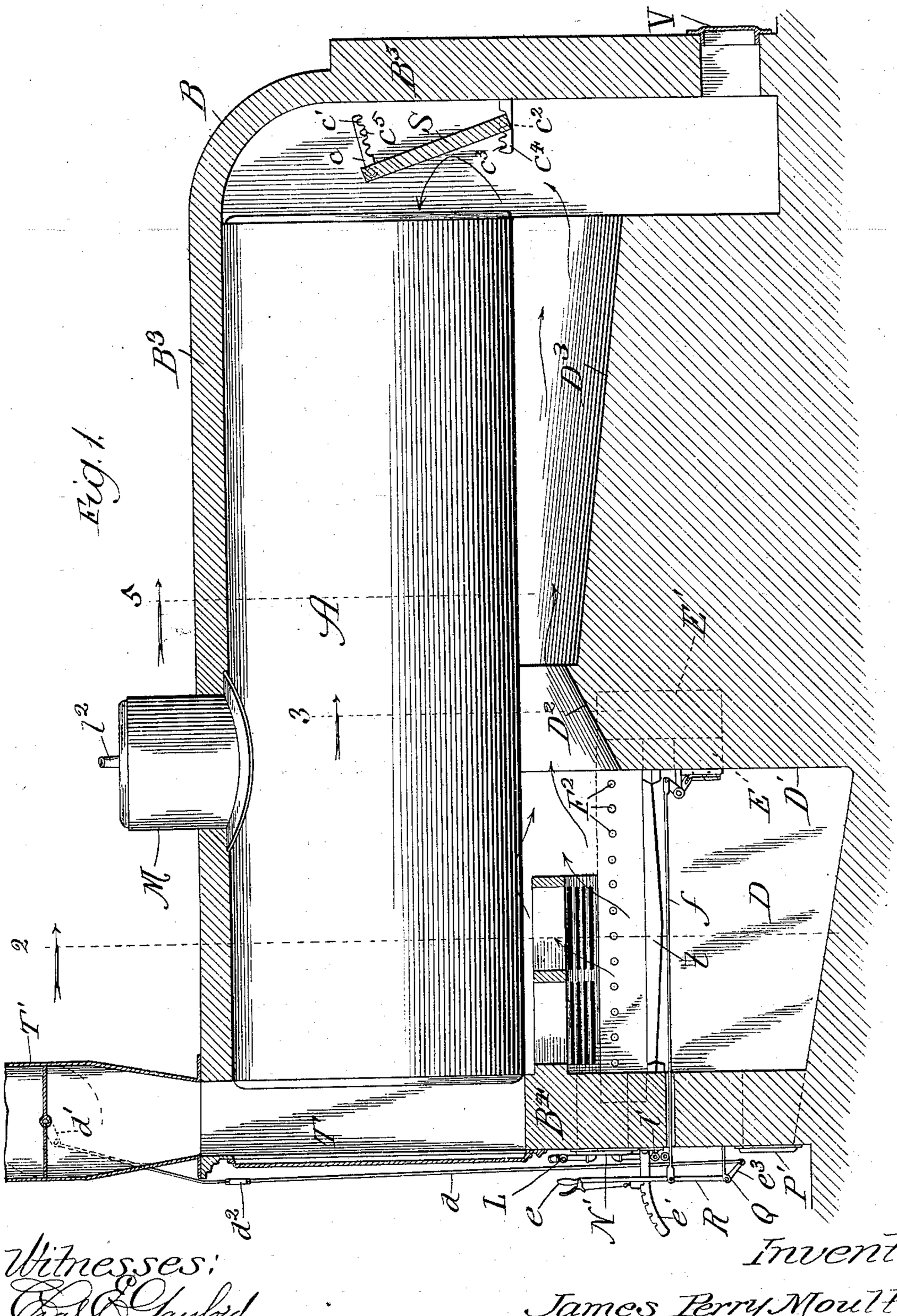

Fig. 1.

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(No Model.) 5 Sheets—Sheet 2.

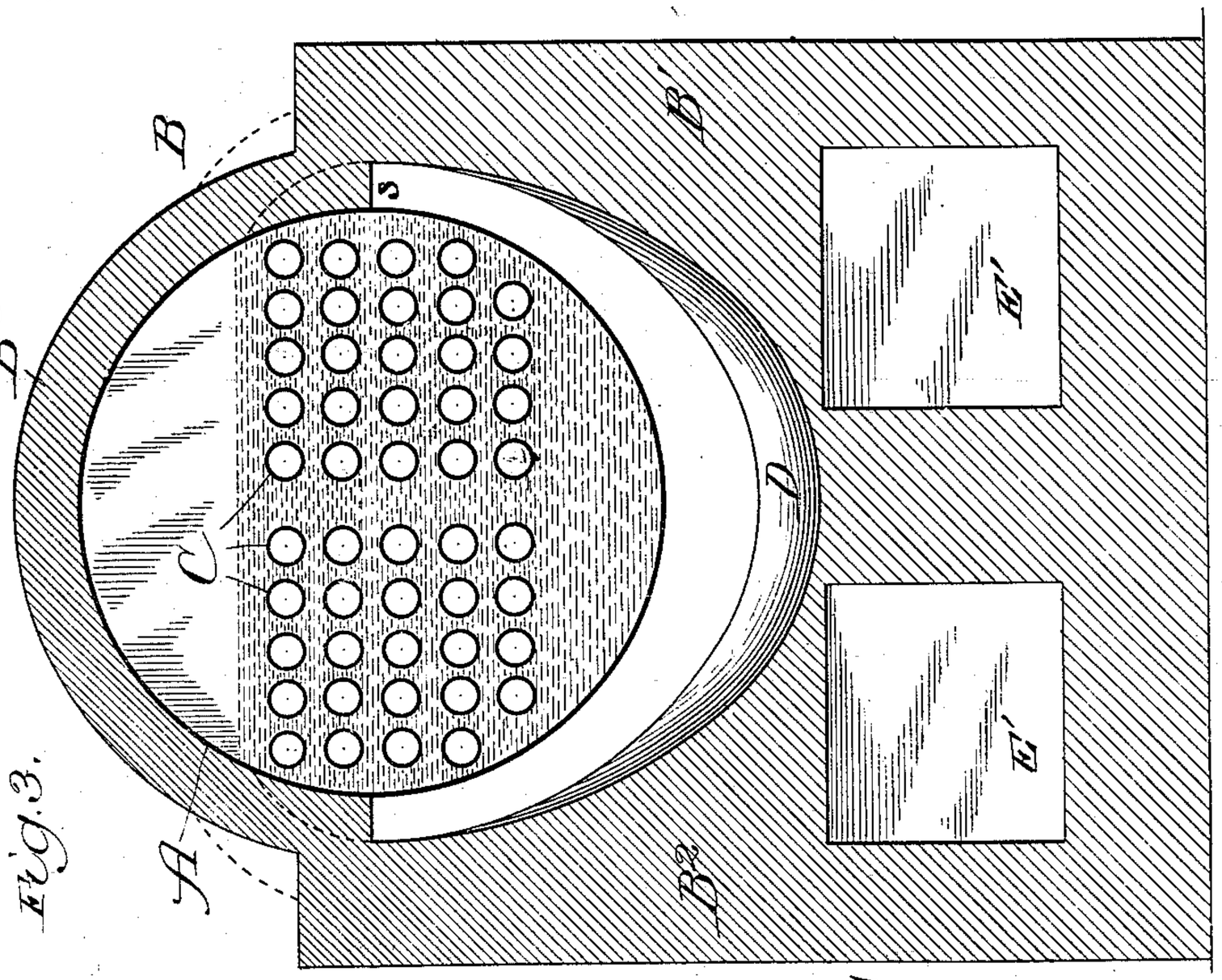

Fig. 3.

Fig. 2.

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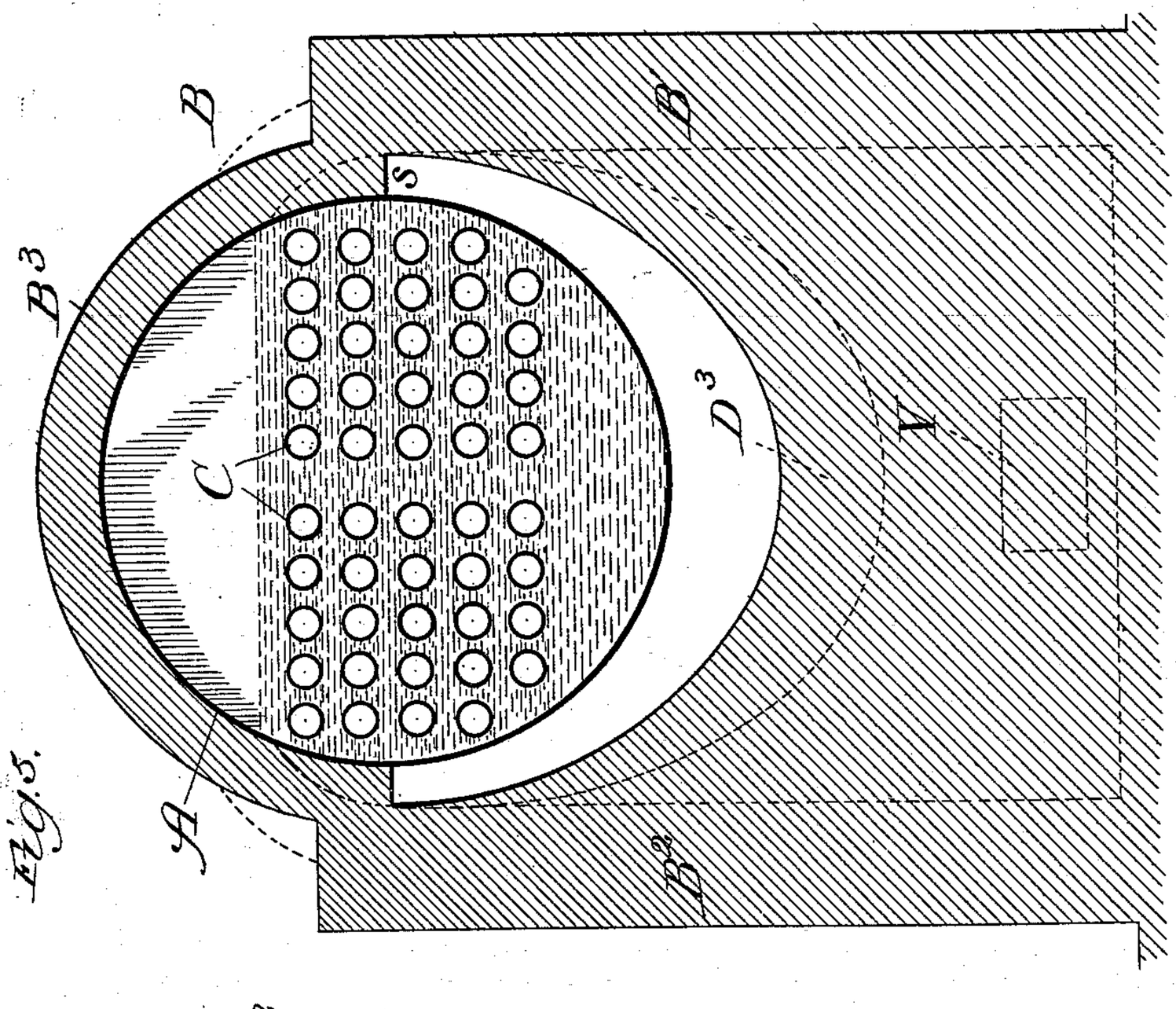

Fig. 5.

Fig. 4.

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(Application filed Aug. 23, 1897.)

(No Model.) 5 Sheets—Sheet 4.

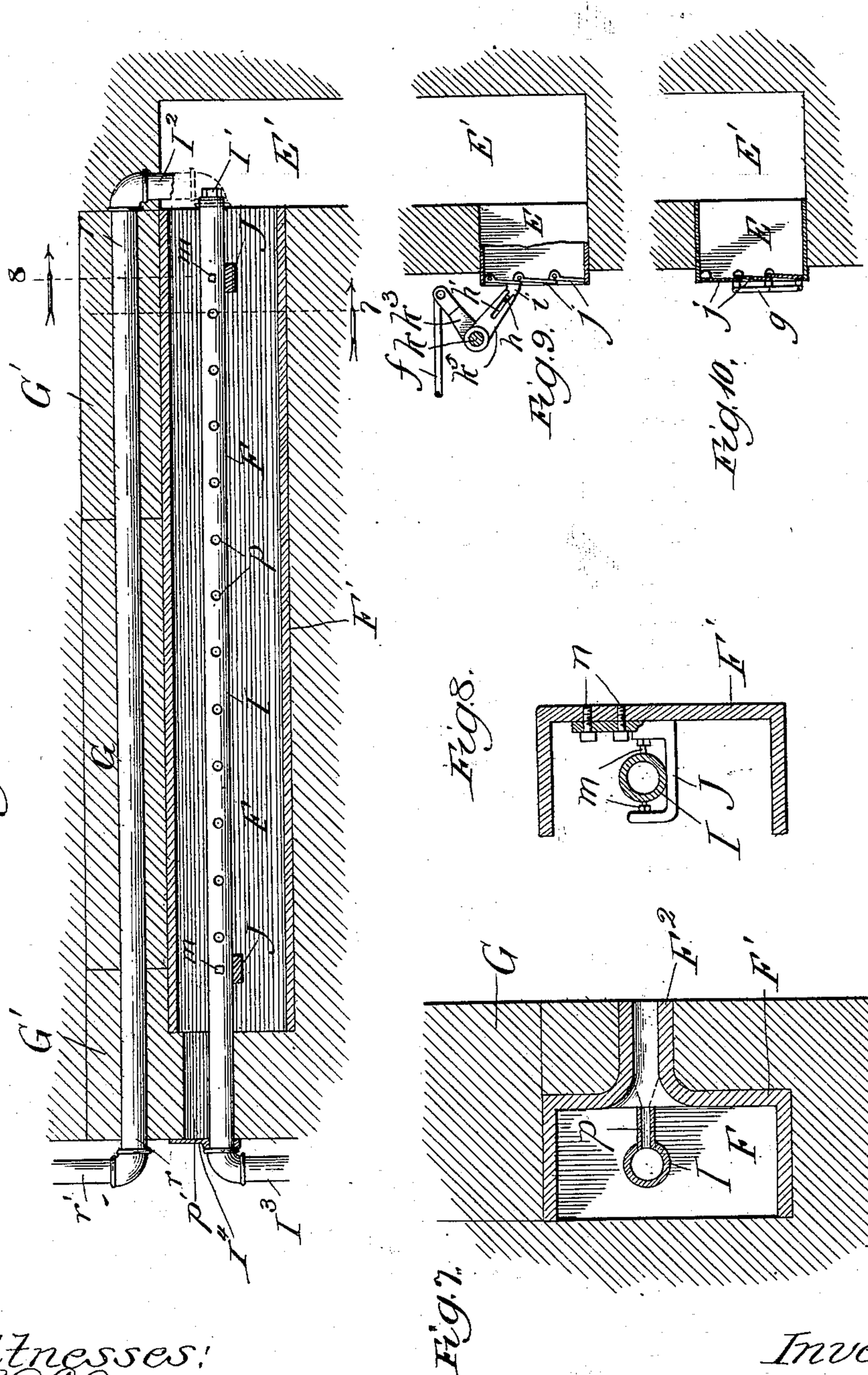

Fig. 6. Fig. 9. Fig. 10.

Fig. 8.

Fig. 7.

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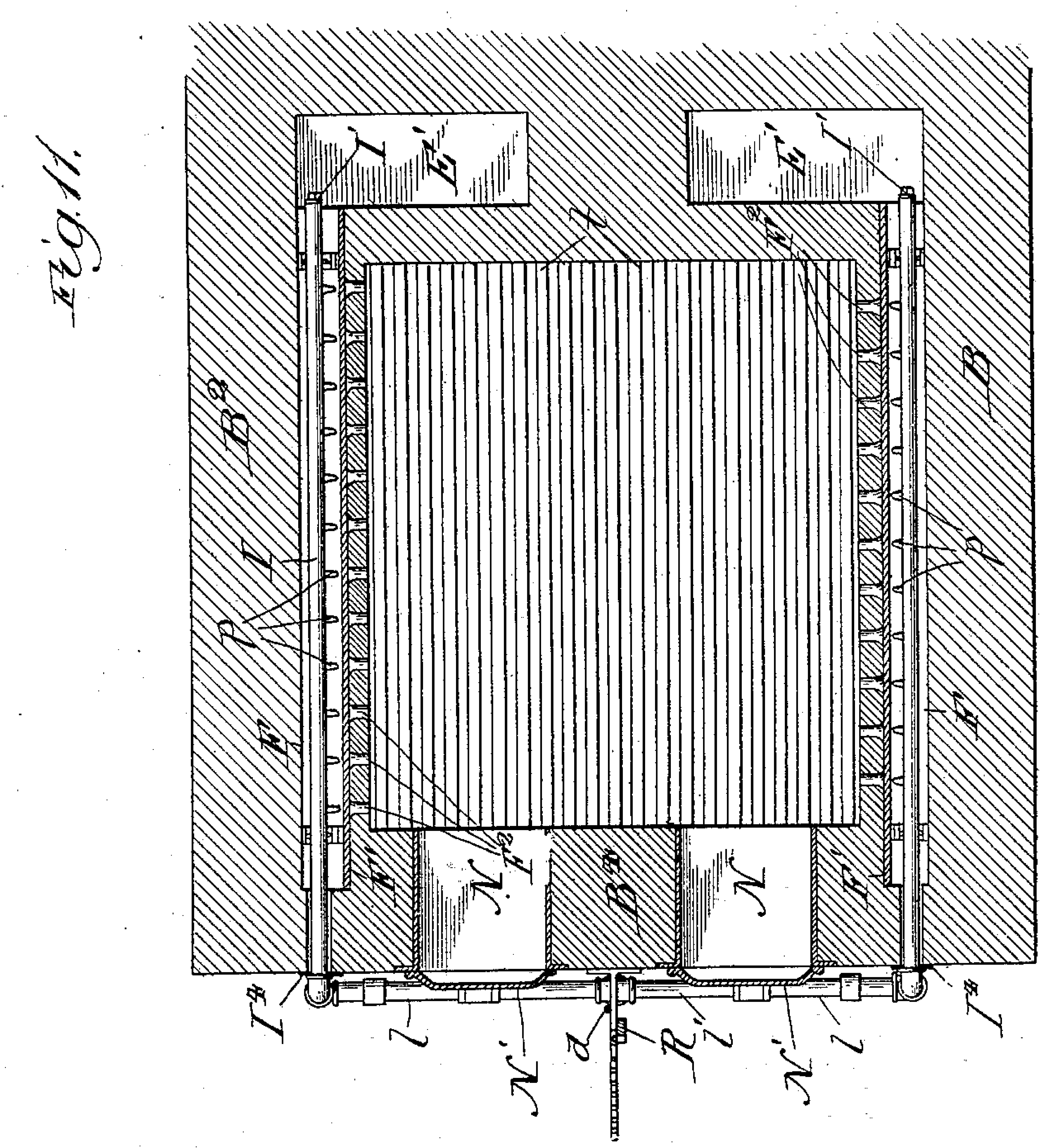
(Application filed Aug. 23, 1897.)

(No Model.) 5 Sheets—Sheet 5.



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UNITED STATES PATENT OFFICE.

JAMES PERRY MOULTON, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO D. S. LOW, OF SAME PLACE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 648,359, dated April 24, 1900.

Application filed August 23, 1897. Serial No. 649,186. (No model.)

To all whom it may concern:

Be it known that I, JAMES PERRY MOULTON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Furnaces, of which the following is a specification.

My invention relates more particularly to an improvement in furnaces for stationary boilers, though certain features thereof may be applied readily to portable boilers of any description—as, for instance, to the boilers of locomotives.

The object of my invention is to provide means for regulating the draft and means for regulating and proportioning the air passing upward through the grate and inward laterally above the same and means for simultaneously operating the regulators and to provide the same with certain new and useful features, hereinafter more fully described, and brought out in the claims.

My invention consists in a damper located in the chimney for regulating the draft and dampers for controlling the passage of air into the furnace above the grate, combined with means for connecting the two dampers, whereby they are operated simultaneously and relatively adjusted.

It also consists in a baffle which extends over the front portion of the grate-bars, where the heat is the greatest.

It also consists in channel-irons placed in the side walls of the furnace and provided with pipes or tubes formed integral therewith and projecting through said side walls, combined with a pipe provided with openings which correspond to the tubes extending through the side walls, supporting-brackets upon which the pipes are supported, and collars secured to the pipes and closing the outer ends of the chambers in which the pipes are placed.

It still further consists in the arrangement and combination of parts, which will be more fully described hereinafter.

Referring to the accompanying drawings, Figure 1 represents a vertical longitudinal section of a boiler and furnace equipped with my improvements; Figs. 2, 3, and 5, vertical transverse sections taken on the corresponding lines of Fig. 1 and viewed in the direction of the arrows; Fig. 4, a front end elevation of the furnace; Fig. 6, a broken section taken at line 6 of Fig. 2 and showing the supply-pipes through which steam is introduced to induce air-currents above the grate-surface; Figs. 7 and 8, sections taken on the corresponding lines of Fig. 6; Figs. 9 and 10, broken sections taken on the corresponding lines of Fig. 2 and showing a shutter-damper and the means for operating it, and Fig. 11 a broken plan section taken on line 11 of Fig. 2 and viewed in the direction of the arrow.

A represents a boiler-shell incased in a suitable inclosing wall B and provided with boiler-flues C. The inclosing wall comprises the side walls B′ and B^2, the arched covering B^3, the front base portion B^4, and the rear wall B^5.

The boiler-setting is provided with a suitable base, affording an ash-pit D, a vertical wall D′ at the rear thereof, which, together with the front base portion B^4, affords supports for grate-bars *t*, a rearwardly and upwardly slanting bridge-wall D^2, and a rearwardly and downwardly slanting rear base portion D^3. Sections through the boiler and setting anywhere along these portions (either through the bridge-wall or rear base portion) disclose a space *s* between the inclosing wall and the boiler-shell, exposing the shell to the heated gases up as far as its horizontal diameter. The base-curve shown upon any of these sections is elliptical in its nature, and all these curves have their extremities in a horizontal plane containing said diameter and in lines parallel to the axis of the shell and at a distance *s* from the shell. It will be understood, however, that these curves may be continued above the horizontal diameter till they intersect with the shell, as shown by dotted lines, it being of importance only that the curve shall show an ever-increasing distance from the shell toward its lowermost portion, where the distance from the shell is greatest. In the vertical wall D′ are passages E, leading to air-chambers E′.

Each side wall is provided just above the grate-surface with a longitudinally-extending rectangular air-channel F, which is formed in the wall by building the wall about a cast channel-bar F′, provided at the web with a series of projecting tubes F^2, which extend inwardly flush with the inner side of the wall. The angles of the channels extend outwardly, and upon the upper one are laid sections of re-

fractory material G, in which is embedded an air-pipe *r*. These sections are beveled on the inner side, as shown, to afford base-surfaces for an arched ceiling H, covering the front portion of the grate for about sixty per cent. of its length. The ceiling is made up of blocks of refractory material, which may be perforated in any suitable manner. The drawings show the arch as made up of slotted blocks of material, which are self-supporting after the manner of a stone arch.

Extending lengthwise of the air-passage F is a steam-pipe I, (see Fig. 8,) which is provided with a series of small laterally-projecting pipes *p*, having minute openings, which register with the tubes F^2. Each pipe is supported on brackets J, secured to the channel F′ by bolts *n*, and is adjustable in said brackets to vary the position of the tubes *p* with relation to the tubes F^2 by means of set-screws *m*, which screw into the pipe and may be caused to bear against the upturned flanks of the brackets.

Where steam is to be used to induce the air-currents, the pipe I is provided at the rear end with a plug I′; but where compressed air is to be used the rear end of the pipe *r* is put into communication with the pipe I through a coupling I^2.

As appears from Fig. 11, the tubes F^2 at one side of the furnace alternate with those at the opposite side of the furnace. The effect of this is to intermingle the currents in a furnace of moderate size and to avoid an impinging of one current upon another and the consequent eddying arising therefrom.

The pipes *r* extend out through the front K of the furnace where they are joined to upturned couplings *r′* and by a right and left handed union r^2 to a horizontally-disposed pipe L, which joins with a supply-pipe L′, which may extend to any source of compressed air, none being here shown.

The pipes I project through the front of the furnace and are joined to downwardly-turned couplings I^3, which are joined by right and left hand unions *l* to a horizontally-disposed pipe *l′*, which communicates with the steam-dome M through the medium of a pipe l^2. To facilitate cleansing of the tubes *p*, the opening through which the pipe I projects is provided with an offset *p′*, through which the tubes will pass when rocked to a vertical position to permit the pipe to be removed.

The front base portion B^4 of the inclosing wall is supplied above the grate-surface with furnace-openings N, guarded by furnace-doors N′, and below the grate-surface with pit-openings P, guarded by pit-doors *p′*.

At the rear of the ash-pit D is a horizontally-disposed shaft *k*, journaled in supports *k′*, rigidly secured to the vertical wall D′. The shaft is provided at its ends with crank-arms k^2 and at its center with an operating-arm k^3. The air-passages E are guarded by shutter devices, each comprising plates *j*, hinged at their tops, the topmost one being provided with a lug *i*, having a laterally-projecting pin *h*, which moves in a slot *h′* in its adjacent crank-arm k^2. The lower plates are pivotally joined to the upper one by a link *g*. (See Fig. 10.) The operating-handle k^3 is pivotally joined to a connecting-rod *f*, Fig. 1, which projects forward through the front wall of the furnace. Secured to the lower part of the front inclosing wall is a bracket Q, on which is pivoted an operating-lever R, provided at one end with a handle *e*, and having spring connection with a notched guide *e′*, rigidly secured to the front wall. The lever R is pivotally connected between its pivotal support and the handle with the connecting-rod *f* and is provided with a projection e^3, which serves as a crank, to which is pivotally joined a connecting-rod *d*, which joins with a crank *d′*, connected with the chimney-damper. The rod *d* is adjustable in length by means of a union d^2. With the connection described a movement of the lever R in one direction operates to close the chimney-damper and both of the air-supply dampers simultaneously and a reverse movement operates to open them simultaneously. By adjustment of the union d^2 the length of the rod *d* is changed to vary the position of the chimney-damper with relation to the shutter-dampers, and thereby to vary the proportion of air passing upward through the grate.

S is a baffle-plate supplied near its upper edge at both ends with pivoted links *c*, provided with notches *c′*. The baffle-plate is further provided near its lower edge with projecting pins c^2. The pins c^2 rest in notches c^3 of a bracket c^4, which projects forward from the rear inclosing wall, while the notches *c′* are hooked over pins c^5, which project inwardly from the side walls. The baffle-plate is preferably set at such a height as to bring its top edge just below the two upper rows of flues of a standard boiler. The adjustment may then be made by the notched links just described till the gases passing through the several flues show approximately the same temperature.

The connection of the flues with the chimney is not shown; but it will be understood that they communicate at their front ends directly with the breech T, which in turn communicates with the smoke-stack T′.

For convenience in cleaning the furnace and adjusting the baffle-plate the rear wall is provided with a manhole V.

Before describing the operation of my furnace it is desirable to recall, briefly, the conditions under which theoretically-perfect combustion may be obtained and to explain the theory upon which I have proceeded in the construction of this furnace. The general statement may be made that air in sufficient quantity must be furnished to the burning fuel and intimately mingled therewith and that the fuel constituents must be maintained at a temperature sufficiently high to permit chemical combination. The theory upon

which my furnace is constructed is that sufficient air should be furnished through the grate to combine with the greater portion of the carbon, the heat thereby generated serving to expel the hydrogen and volatile compounds from the fuel and that a sufficient quantity of air (properly distributed) should be furnished above the grate-surface to combine with any particles of carbon which may be torn from the fuel-body and also with the unconsumed gases which arise from the solid fuel. I believe that carbonic oxid is formed in very small, if any, quantity, and that if any is formed the air necessary to convert it into carbon dioxid is furnished by the side-to-side draft above the grate-surface. The flame indicates the presence of the monoxid in appreciable quantity only at the moment of firing and while the furnace-door is open. This is the only period also when the products issuing from the chimney are visible. It is probable that the intense white flame which shows to a height of about six inches above the grate-furnace and does not, under proper conditions in any instance, pass the bridge-wall, is due to the burning hydrogen and to the momentarily incandescent particles of carbon which have been torn from the fuel-body and which are caught by the side-to-side currents passing above the grate-surface and at the moment of combustion are heated to incandescence. It is probably true that with the intense heat maintained in this furnace and where steam is used for forcing the air-currents the steam, although present in small quantity, is decomposed by the hot carbon which combines with the oxygen, the freed hydrogen again uniting with oxygen of the air after it has moved away from the carbon, this being analogous to the manner in which carbon dioxid is decomposed by passing over heated carbon, and the product carbon monoxid again reunites with oxygen of the air under favorable conditions to form again the dioxid.

Where steam is to be used, the pipe *r* is left unconnected with the pipe I, the end of the pipe I being closed by means of the cap I′. Steam is now admitted to the pipe I through the steam-valve W. The pit-doors are left open and the lever R, connected with the chimney-damper and the air-passage shutter-dampers in the manner described, is moved to the proper position to give the required draft. Steam issues from the minute openings (from one-fiftieth to one-eightieth of an inch in diameter) of the tubes *p* directly into the tubes F^2 and induces currents through those tubes, drawing the air through the channels F, the chambers E′ E, and finally through the shutter devices and pit-doors.

Artisans skilled in the construction and operation of these furnaces are able to so adjust the connections between the chimney-damper and the shutter devices as to furnish the proper amount of air through the grate and from the sides above the grate for any given fuel. They are able also to so adjust the pipe I with relation to the casting F′ as to secure with steam at a given pressure the maximum amount of draft with a minimum amount of steam. This is a very important feature for reasons above suggested.

Where compressed air is to be used, the cap I′ is removed and the coupling I^2 is used to join the pipes I and *r*. The steam-valve is closed and air is admitted through the pipe L′, which is joined to a suitable source of supply. All the air admitted above the grate-surface is warmed by passing a part beneath the grate and then through the passage F and the remainder through the pipe *r* and then through the pipe I. The side-to-side currents intermesh by reason of the location of the tubes (shown in Fig. 11) and form a sheet of air which effectually entangles any unconsumed carbon or gas which may rise from the fuel-surface and supplies the air necessary to complete the combustion. The products of combustion pass a part through the perforated arch H and thence backward over the bridge-wall and a part beneath the arch and then back over the bridge-wall. The arch is of quite thick refractory material and besides protecting the boiler from the hottest part of the fire serves to absorb and give off heat during variations of temperature in the fire, thus serving as an equalizer to preserve the evenness of temperature. The peculiarly-shaped passages afforded above the bridge-wall and rearwardly-slanting floor D^3 serve to conduct the heated gases close to the boiler-surface. Such a construction is rendered possible by reason of the fact that combustion being completed before the bridge-wall is passed the large combustion-chamber heretofore used in the rear of the bridge-wall may be dispensed with. The products pass from the last-named chamber backward and upward against the baffle-plate S, which deflects a portion of the hottest gases into the lower flues. This is of the greatest importance, since it equalizes the work of the boiler-surface, and the water being evenly heated is changed to steam without the violent evolution so productive of saturated steam common to the old construction. The gases pass from the flues directly to the breech T and thence to the stack T′.

It may be added that for any given fuel the open chimney area (regulated by the chimney-damper) should bear a certain ratio to the air-passage areas (regulated by the shutter-dampers) and that once this ratio is ascertained and the damper devices are connected properly, whether by changing the length of the rod *d* or in any other suitable manner, the connection remains fixed and the dampers are operated simultaneously in the manner described.

There remains yet to be described the manner in which the pipes I are removed for cleaning the twyers *p* should any of the minute openings become clogged. This operation is

a very simple one where, as in the most ordinary case, steam is used for the blast. To permit removal of the pipes, the openings through which they pass at the front wall are slightly enlarged and provided with offsets, as described, and these enlargements are covered by collars I^4, secured to the pipes. It is necessary, therefore, only to uncouple the joints I^3 and rock the pipes to bring the tubes *p* to the vertical position, when they will slip by the brackets and out through the offsets. The set-screws above mentioned are made so short as to pass readily through the opening with a slight shifting of the pipe.

It will be understood that certain features of my invention may be applied to other than shell-boilers, and I desire to be understood as intending by the particular description given above merely to point out clearly the manner of applying the invention to this particular class of boilers and not to limit myself in any particular thereby, except as shall appear from the appended claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a furnace, the fire-chamber, the grate, and a chimney, combined with a damper placed in the chimney, a rod connected thereto, a lever by means of which the rod is operated, a rod connected to the lever and extending through the ash-pit, a suitable door or damper operated by the inner end of the rod, air-passages made in the walls of the fire-chamber, and openings through said walls through which the air passes, substantially as shown.

2. In a furnace, the fire-chamber, suitable openings through its side for the introduction of heated air, the grate, a chimney, a damper located in the chimney, a rod by means of which the damper is operated, and a lever to which the rod is connected, and by which it is operated, combined with a rod connected to and operated by the lever and which rod extends into the ash-pit; a crank-lever connected to the inner end of the rod, and provided with slotted ends, doors or dampers provided with projections and which are operated by said lever, and air-passages through the walls of the chamber; the damper in the chimney, and the dampers for the air-passages being operated simultaneously, substantially as described.

3. In a furnace, the combination of a fire-chamber of general rectangular plan, a grate therefor, a pit beneath the grate, a front furnace-wall provided with openings to said fire-chamber and pit, side walls provided with air-channels leading from the pit and provided with openings into said fire-chamber above the grate, air-pipes leading from the front of the furnace to the rear of the fire-chamber and incased in the side walls, air-pipes in said air-channels provided with tubes registering with the lateral openings into said fire-chamber, a connecting-pipe I^2 joining each set of the pipes mentioned, a chimney through which the gases escape, a damper for the chimney, and dampers for said air-channels, substantially as described.

4. In a furnace, the combination with a chimney, fire-chamber, and grate, of furnace-walls provided with an air-channel having openings into said fire-chamber above the grate-surface, and a compressed-fluid pipe in said air-channel provided with inwardly-projecting tubes registering with said openings, and means for supporting said pipe and adjusting its inwardly-projecting tubes with relation to the openings into the fire-chamber, substantially as and for the purpose set forth.

5. In a furnace, a chimney, a fire-chamber, a grate therefor, the side walls provided with air-chambers, channel-bars placed in the chambers and having tubes or pipes formed integral therewith, combined with pipes provided with projecting tubes which correspond to the tubes or pipes formed upon the channel-irons, suitable brackets secured to the channel-irons, and which form supports for the said pipes, and means for adjusting the pipes upon the brackets, substantially as shown.

6. In a furnace, the combination with a chimney, a damper therein, a fire-chamber, a grate therefor, a pit beneath the grate, doors opening to the fire-chamber and pit, side walls provided with air-channels leading from the pit and having lateral openings into the fire-chamber above the grate-surface, compressed-fluid pipes supported in said channels and provided with inwardly-projecting tubes registering with said openings, dampers guarding said air-channels, and a lever pivotally joined to the front furnace-wall and operatively connected with the chimney-damper and air-channel dampers for moving them simultaneously, substantially as and for the purpose set forth.

7. In a boiler-furnace, the combination with a fire-chamber, grate therefor, a horizontally-disposed boiler-shell above the fire-chamber, a passage beneath the boiler from the fire-chamber to the rear end of the shell, and an adjustable baffle-plate between the shell and rear inclosing wall for deflecting a portion of the highly-heated gases into the lower flues, substantially as and for the purpose set forth.

8. In a furnace, the side walls having chambers formed therein, channel-castings placed in the chambers and provided with suitable openings which extend through into the furnace, and the brackets secured to the channel-castings, combined with pipes supported upon the brackets, means for adjusting the pipes upon the brackets, and the collars secured to the pipes and closing the outer ends of the chambers, whereby the pipes are made removable from the chamber, substantially as shown and described.

JAMES PERRY MOULTON.

In presence of—
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R. T. SPENCER.