(No Model.) 3 Sheets—Sheet 1.

A. WORTHINGTON.

SELF FEEDING GAS BURNING FURNACE.

No. 310,110. Patented Dec. 30, 1884.

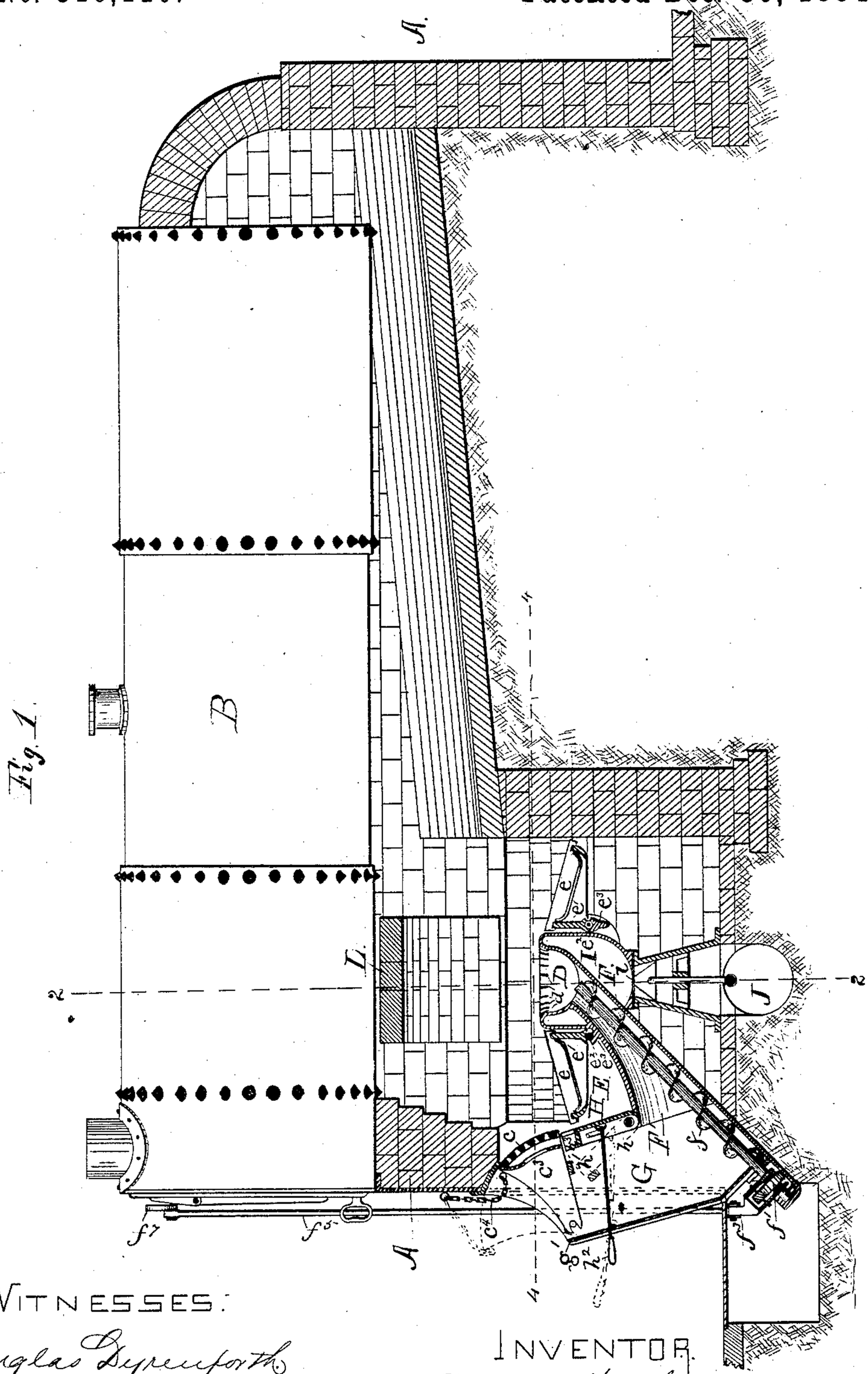


Fig. 1.

WITNESSES:

Douglas Dyrenforth.

W. G. Rainey.

INVENTOR.

Per Amasa Worthington

D. H. Fletcher,

his ATTORNEY

(No Model.) 3 Sheets—Sheet 2.

A. WORTHINGTON.

SELF FEEDING GAS BURNING FURNACE.

No. 310,110. Patented Dec. 30, 1884.

Fig. 3.

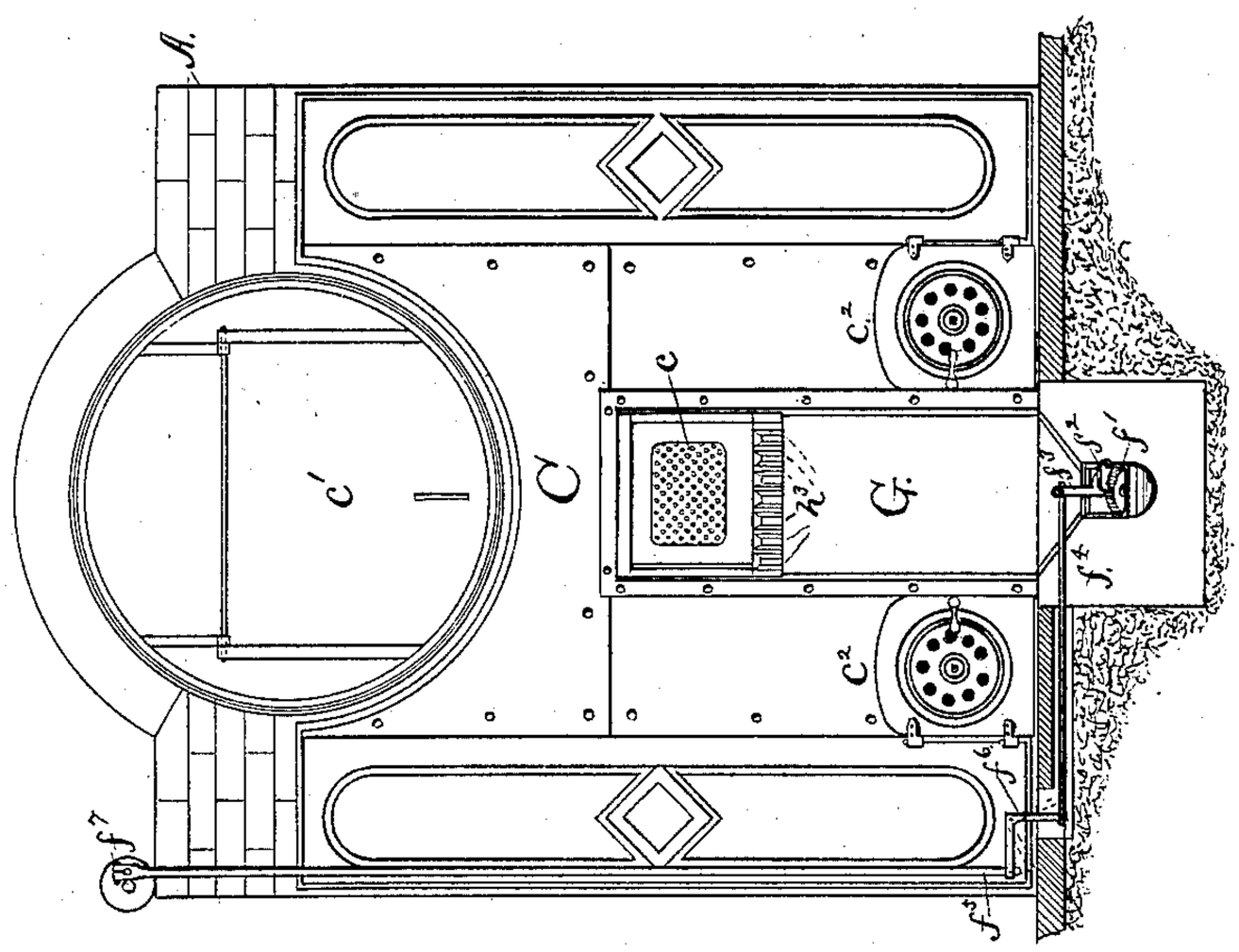
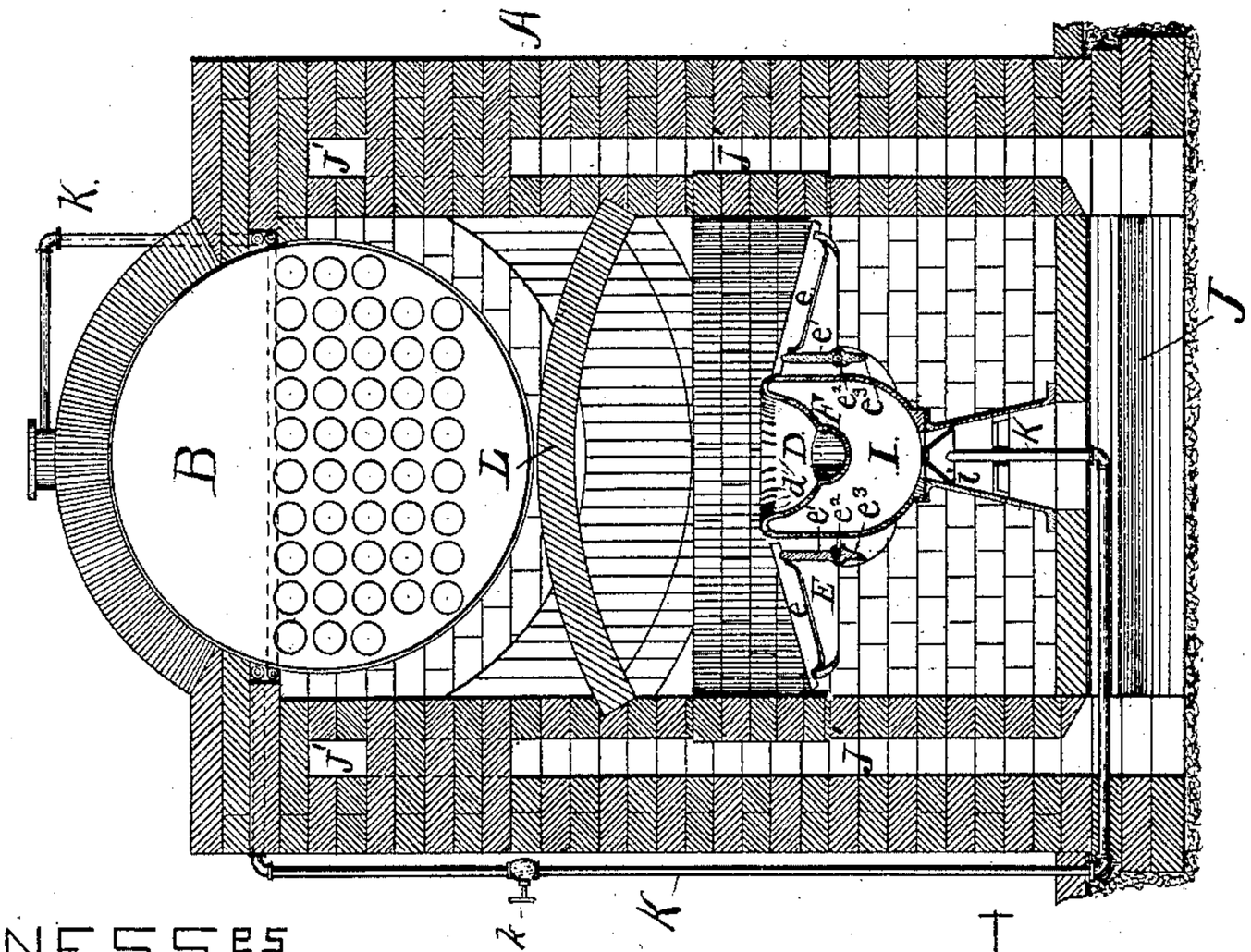


Fig. 2



WITNESSES

Douglas Dysenforth

W. G. Rainey

INVENTOR

Amasa Worthington.

per D. H. Fletcher

his Atty.

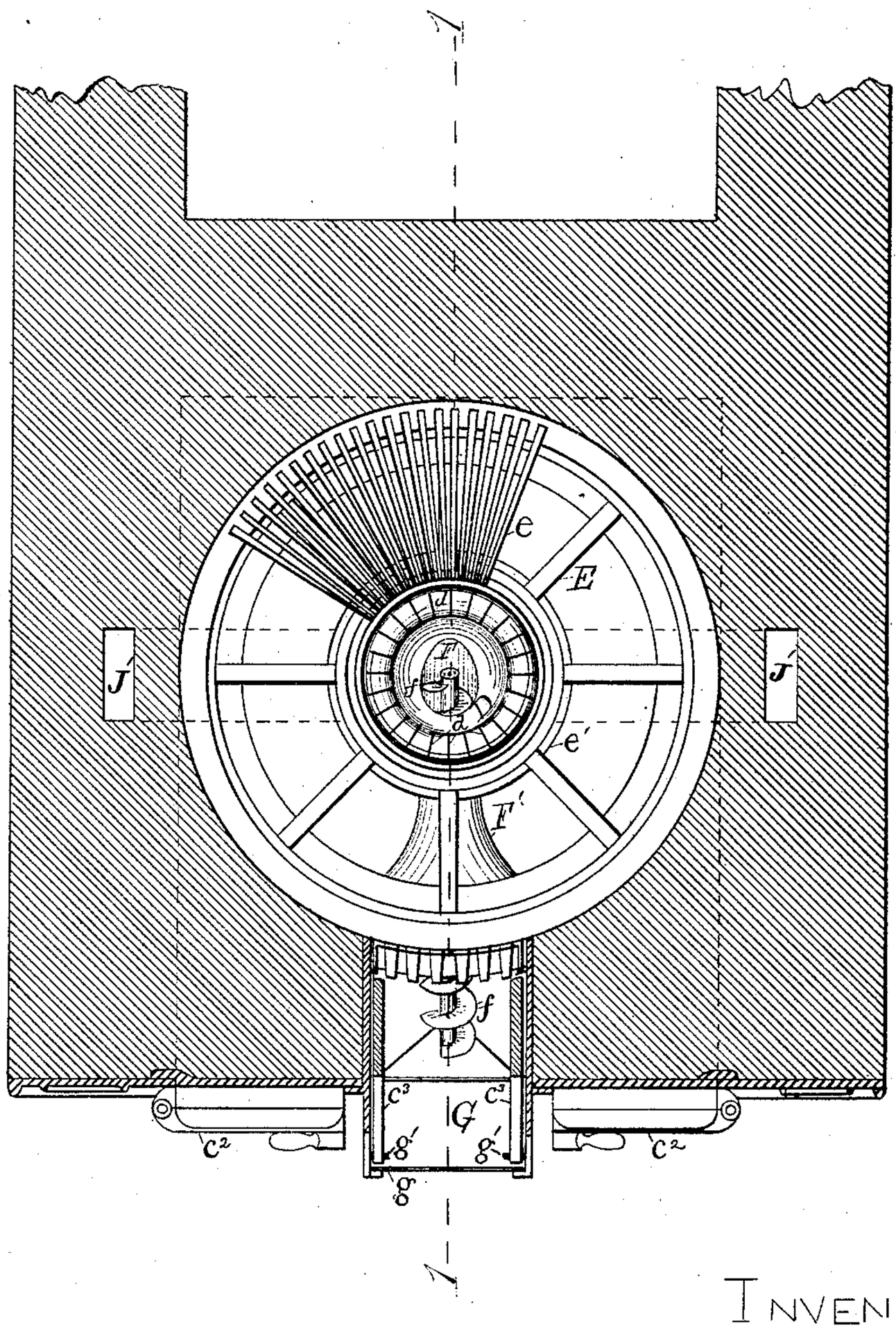
(No Model.) 3 Sheets—Sheet 3.

A. WORTHINGTON.

SELF FEEDING GAS BURNING FURNACE.

No. 310,110. Patented Dec. 30, 1884.

Fig. 4.



WITNESSES:

Douglas Dalrymple

W. G. Rainey

INVENTOR:

Amasa Worthington

Per D. W. Fletcher

his ATTORNEY.

UNITED STATES PATENT OFFICE.

AMASA WORTHINGTON, OF CHICAGO, ILLINOIS.

SELF-FEEDING GAS-BURNING FURNACE.

SPECIFICATION forming part of Letters Patent No. 310,110, dated December 30, 1884.

Application filed November 30, 1883. (No model.)

To all whom it may concern:

Be it known that I, AMASA WORTHINGTON, of Chicago, Illinois, have invented a new and useful Improvement in Self-Feeding Gas-Burning Furnaces, of which the following is a description, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view cut through the line 1 1, Fig. 4. Fig. 2 is a transverse vertical section cut through the line 2 2, Fig. 1. Fig. 3 is a front view, and Fig. 4 is a plan view on the line 4 4, Fig. 1.

Like letters of reference indicate like parts in the different figures.

It is a universally-admitted fact among furnace-builders and users that, to obtain the best results from coal as a fuel, it should be supplied in small charges, or, better still, fed into the furnace continuously in quantities or at a rate corresponding to the rate of combustion. Numerous attempts have been made, with more or less success, to accomplish this result; but the experiments have proceeded upon the theory that it is necessary to throw the fresh coal upon that which is partially consumed or in an incandescent state, or to deposit it at the side or in front of the fire, and thus permit the hydrocarbon gases to distill or partially distill from it before spreading it over the fire, both of which methods are attended with loss, not only in the direct absorption of heat by the coal, but in the sudden arrest of combustion (caused in a measure thereby) of the fixed carbon or coke, as well as the equally sudden liberation of the volatile gases in the fresh charge, amounting often to thirty or forty per cent. of the total heating-power of the coal, which passes off unconsumed, a large volume of smoke being an attendant result. Aside from this, the loss in the latter plan arises largely in the difficulty in maintaining an even fire, and in the fact that certain varieties of coal containing a large per cent. of non-combustible matter are liable to become "puddled" when the coke is moved in an incandescent state. Moreover, it is difficult, if not impossible, in either of these ways to diffuse the air throughout the mass of coals and mix the same in a sufficiently even manner with the evolving gases, while the same are at a sufficiently high temperature to form a chemical union therewith.

The purpose of my invention is to overcome these difficulties, and to produce an automatic-feeding smokeless furnace, preferably adapted to the use, without direct loss, of bituminous coals of varying grades of fineness, said furnace being arranged to so distribute said coals that combustion may be uniform in its progress and intensity, and that the principal heat-producing elements of the coal—viz., the hydrocarbons and the fixed carbons—may be so treated therein as that the combustion of one may assist that of the other, each receiving the required proportion of oxygen at the proper time and in the proper place to support combustion.

A further object is to so arrange said furnace that the ashes and clinkers may be readily and easily removed from the grate, and the fire broken up, if necessary, without subjecting the latter to excessive and cooling drafts of air, the advantages and economy of which are obvious. I accomplish said object by feeding the coal from beneath the grate into a bowl-shaped receptacle situated at or near the center of said grate, which is preferably round, and the bars of which radiate from the periphery of said bowl. The top or periphery of the bowl is provided with slots or openings, preferably made in a radial form, which communicate with a chamber beneath the bowl, into which a volume of air is forced either by means of a blower or a jet of steam. Said slots are so constructed as to direct the jets of air, or air and steam, therefrom into and through the fresh coal at the earliest stage of combustion, in order to drive out the hydrocarbon and other volatile gases and reduce it to coke as rapidly as it is forced up into the furnace, and before it begins to spread out on the grate-bars, and to thus maintain the incandescence of the fire at the point on the surface from which the hydrogen gases must escape, thereby reducing them to a thorough state of combustion as they leave the surface. As an auxiliary to this process I place an arch above, which serves as an accumulator to radiate its heat back upon the burning mass and maintain it in an incandescent condition. Openings above the grate in the usual way admit air, which, with that ordinarily passing through the grate, serves to complete the combustion of the coke by com-

bining with the carbonic oxide that might otherwise escape and converting it into carbonic acid. As the coal is forced up at a given point from beneath, it tends to form a dome-shaped mass, the residue from the top rolling toward the base, at the outer circumference of which the ashes are deposited upon the grate-bars where the latter are the most widely separated from each other, thus lessening the waste of fuel through the grate by retaining the unconsumed coals upon that more central portion of the grate where the bars are closer together. The coal is fed upward by means, preferably, of a single Archimedean screw or conveyer, which I prefer to place at an angle of about forty-five degrees from the plane of the horizon, the lower end communicating with a hopper or receptacle containing the coal supply, while the upper end communicates with the bottom of the bowl or receptacle, forming a part of the grate. When the screw is revolved, as hereinafter shown, the coal is carried into the bottom of the bowl, and thence forced upward until it overflows the top and is pushed out upon the grate, the supply being in proportion to the required rate of combustion, all of which is hereinafter more fully stated, and definitely pointed out in the claims.

In the drawings, A represents the walls or case of the furnace in which the boiler B is placed, the front being provided with the usual iron plate, C, (better shown in Fig. 3,) to which is secured the various doors, c c' c^2 c^2, for access to the furnace, the boiler-flues, and ash-pit, respectively. The hopper or fuel receiving-bowl D is arranged, as clearly shown in the drawings, in the center of the furnace-well, thus forming a part of what would otherwise be the grate-surface, the grate E, which is preferably round, surrounding the same, and its bars e, which are preferably removable, radiating therefrom, as shown in Fig. 4, so that the space between them at the outer edge or periphery is somewhat greater than at the opposite ends. An annular groove upon the bottom of the ring e', Figs. 1, 2, and 4, permits the grate to be supported upon balls e^2, resting in a corresponding groove in the support e^3, by means of which the grate may be revolved at will and any part brought to the front for cleaning, as hereinafter shown.

Connecting with the bottom of the receiving-bowl D is a trough or pipe, F, into which is placed a spiral conveyer, f, to the shape of which the bottom of said trough is made to conform. The lower end of the shaft of said conveyer f rests in a socket, f', at the bottom of the trough, in which the former turns, and by which it is supported, the conveyer otherwise resting loosely in said trough F. It will be seen by reference to Figs. 1 and 2 that the top or covering F′ of said trough is enlarged, as it passes downward, to permit the coal which is stowed in the hopper to be carried upward without obstruction, as well as to afford a somewhat larger storage-place. Said extension or covering F′, together with the other parts, is made sufficiently tight to prevent the ashes from the grate from falling into the fresh coal. The case g, Fig. 1, of said hopper is slanted outward, as shown in said figure. Upon the side of said case are pins g' g', Figs. 1 and 4, upon which the door c is pivoted by means of flanges or arms c^3 c^3, said door being prevented from swinging over by the chain c^4, Fig. 1, its position when open being indicated by the dotted lines shown in said figure.

In order to rake the cinders from the grate and deposit the same in the ash-pit, I provide a door or plate, H, which also forms one side of the hopper G, (better shown in Fig. 1,) hinged at h, and adapted to fall back against the abutment h', as indicated by the dotted lines. The top of said door is provided with fingers or grate-bars h^3, Figs. 1 and 3, through which a "slash-bar" may be inserted to loosen up the clinkers. Said door gives ample room for the removal of the cinders which fall over the trough-covering F′ into the ash-pit, from which they may be removed through the doors c^2 c^2. The door H is operated and retained in position by means of the rod h^2, Fig. 1, the handle of which extends through the front plate of the hopper G, and being provided with a notch or projection thereon to secure the same in position.

Beneath the bowl D is a hollow chamber, I, Figs. 1 and 2, preferably in the form shown in the drawings, communicating through the funnel-shaped orifice i with the air shaft or pipe J, Figs. 1 and 2, which in turn communicates with the air-passages J′ J′, the latter being carried upward and back and forth, as shown in Fig. 2, through the furnace-walls, to permit the air passing through them to become thoroughly heated before reaching the chamber I. A steam-pipe, K, from the steam-dome is carried down, as shown in Fig. 2, next to the boiler-shell, and, after traversing the length of the boiler, is carried through the same, above the flues, as indicated in dotted lines, and downward outside of said furnace-wall, where it is carried into the air-flue J, and thence upward, terminating in the funnel-shaped orifice i. The flow of steam through said pipe is controlled by means of the valve k. It is obvious that, by reason of its length of travel, as shown, the same must become highly superheated, in which condition it passes into the chamber I, carrying therein from the pipe J and its connections a blast of hot air.

Surrounding the periphery of the bowl D, are openings or slotted orifices d, through which openings said air and steam from the chamber I are forced into and through the coal, thus mingling uniformly with the gases evolved. An arch, L, of fire-brick is placed above said bowl D, to serve as a heat-accumulator to radiate the heat back upon the fuel, as stated. A large number of small holes, c^4, through the door serve to admit a flow of air above

the fire in such manner as to insure complete combustion.

Upon the lower end of the shaft of the conveyer *f* is placed a ratchet-wheel, *f'*, Figs. 1 and 3, with which a pawl, f^2, engages, said pawl being actuated by an arm, f^3, connected by the rods f^4 f^5, bell-crank lever f^6, and crank f^7, which may be rotated by the engine in any well-known manner.

It is apparent that the conveyer *f* may be revolved by means of a bevel or worm gear, it being of little consequence what means are used so long as the motion is even and of a satisfactory rate of speed.

The operation of said furnace is as follows: The hopper G being supplied with coal of a sufficient degree of fineness to pass readily through the pipe F, the same is carried upward by said conveyer, filling the bowl D, which soon overflows, when the coals are deposited upon the grate, the bars *e* of which are preferably slanted downward, as shown, until the whole mass is formed in a kind of oval or dome shape, the greatest depth being above the bowl. The jet of steam from the pipe *k* forces a hot-air blast into the chamber I, the shape of which, in conjunction with the funnel-shaped orifice *i*, tends more or less to compress the air and steam in said chamber, from which it issues with great force through the openings *d*, thereby being generally distributed through the fresh coal at the earliest stages of combustion or distillation. A sufficient amount of oxygen is thus brought in contact with the fresh fuel to unite with and wholly consume the hydrocarbon gases first given off, and I aim thereby to produce a sufficient heat to decompose the superheated steam, and, by adding its hydrogen to that simultaneously evolved from the coal, a flame of the utmost intensity is produced at the outset, and the coals passing up from the bowl D are rendered incandescent before reaching the top or surface of the fire, at or near which point the second stage of combustion—viz., that of the fixed carbons—commences, the arch L in the meantime serving to accumulate the heat and reflect the same back upon the mass of coals, which are thus uniformly retained in their incandescent state. It is obvious that in introducing the coals in this manner the ashes must be deposited upon the outer circle of the grate as fast as formed, and, as the grate-bars are wide apart there, they readily fall through, all clinkers and cinders being removed in the manner shown. As most bituminous coals have more or less tendency to cake and mass together when reduced to coke, it is obvious that very small or fine coal may be used in this manner without falling through the grate, as the same will have reached an incandescent state before passing over the edge of the bowl onto the grate-bars, which, it will be observed, are closer together where said coal is brought in contact therewith. The furnace may be regulated by turning off the steam-jet and stopping the supply of coal, when the fuel will smoulder upon the grate until a greater degree of heat is required, when the blast may be continued.

It is clearly apparent that when a large grate-surface is required two or more conveyers placed side by side, with corresponding receptacles, D, may be used either with a like number of revolving grates or a stationary grate, in which latter case, instead of two or more circular receptacles, a single oblong trough may be used, with which the several conveyers may connect. I do not limit myself, therefore, to the use of a single conveyer, nor to the form of receptacle shown, as it is evident that the same may be modified to produce substantially the same results; nor do I confine myself to the use of a hot-blast introduced in the manner shown, as cold air injected by means of a blower may produce very satisfactory results.

It is obvious that the conveyer described may be worked by hand instead of by the ratchet mechanism, and by turning the same frequently, so as to introduce a small quantity of fuel at a time, may effect nearly if not quite as complete combustion as if worked continuously.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A furnace substantially as described provided with a suitable receptacle at or near the center of the grate for the reception of the coal from beneath, and a chamber surrounding said receptacle, with means, substantially as described, for forcing therein a volume of air or air and steam, and suitable orifices in the periphery of said receptacle for the admission of said air or air and steam into the coal, substantially as described.

2. The combination, with a furnace, of the hopper G, conveyer *f*, and receptacle D, arranged at or near the center of the grate, with means, substantially as described, for injecting a blast of air or air and steam into and around the periphery of said receptacle, for the purposes set forth.

3. The combination, with a furnace, of the hopper G, conveyer *f*, and receptacle D, arranged at or near the center of the grate, with means, substantially as described, for injecting a blast of air or air and steam into and above said receptacle, and a heat-accumulator or arch above said bowl, for the purposes substantially as set forth.

4. A furnace in which the coal is automatically fed from beneath the grate by means of a spiral conveyer communicating with a suitable hopper, combined with a circular revolving grate, door, or plate, H, and rod h^2, for securing and regulating the same in any required position, substantially as and for the purposes specified.

5. A furnace in which the coal is fed upwardly from beneath the grate by means of a spiral conveyer placed at an angle to the plane of the horizon, the upper end of said conveyer

communicating with a bowl or other receptacle in the grate, and means, substantially as described, for injecting a blast of air or air and steam into said fresh coal at or near the periphery of said bowl, whereby the volatile gases may be liberated and consumed and the coal coked before spreading upon the grate-bars, substantially as and for the purposes set forth.

6. A furnace in which the fuel is continuously fed from beneath the grate into a suitable bowl or receptable by means of a conveyer, substantially as described, said furnace being provided with the within-described facilities for forcing a blast of air or air and steam into the fresh fuel as the same is continuously fed therein, whereby the volatile gases may be liberated and consumed at the earliest stage of the combustion of said fuel, substantially as and for the purposes set forth.

AMASA WORTHINGTON.

Witnesses:
D. H. FLETCHER,
DOUGLAS DYRENFORTH.