No. 704,325. Patented July 8, 1902.

H. F. HAYDEN.

SMOKE PREVENTING FURNACE.

(Application filed Dec. 14, 1900. Renewed Apr. 19, 1902.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

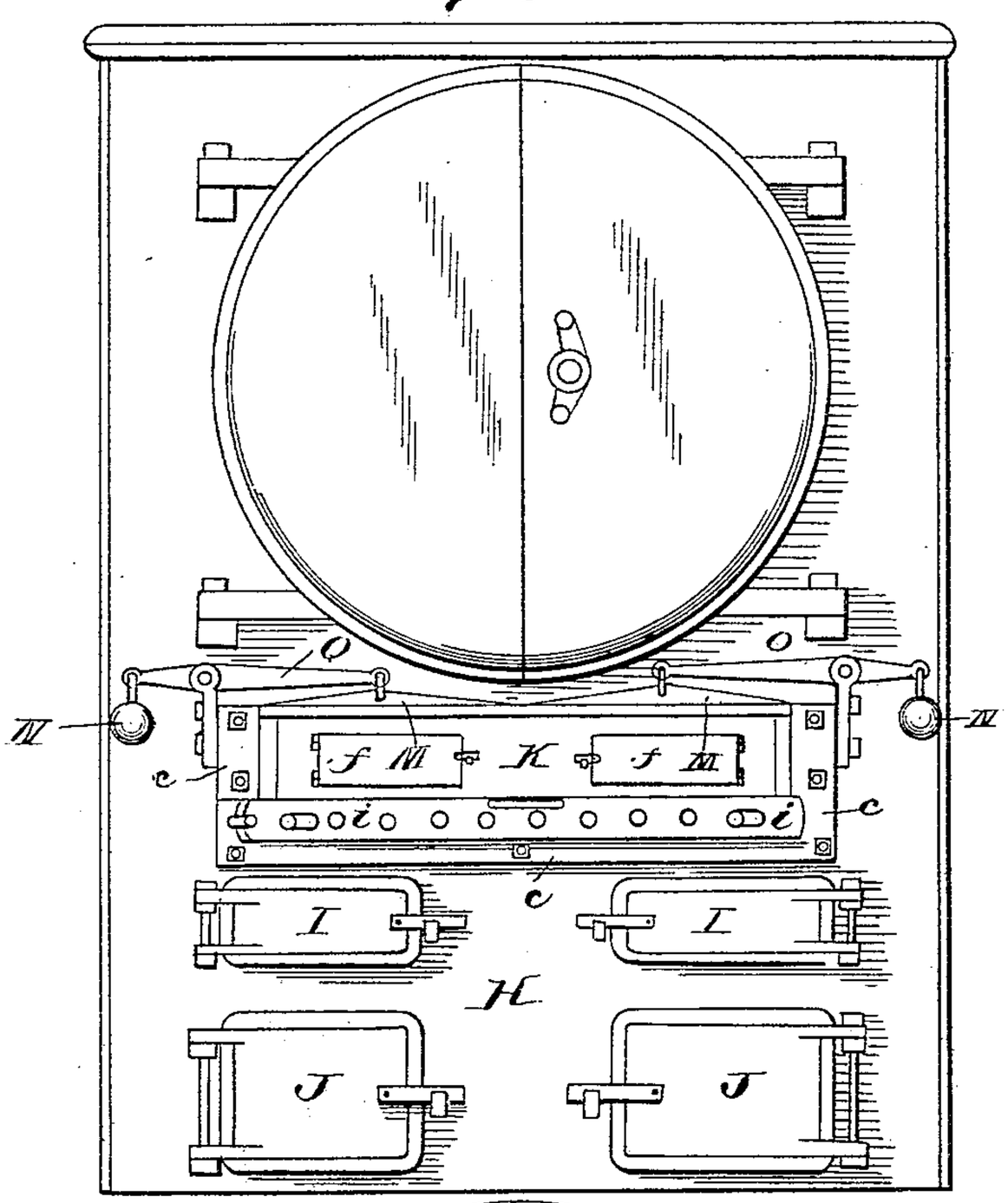
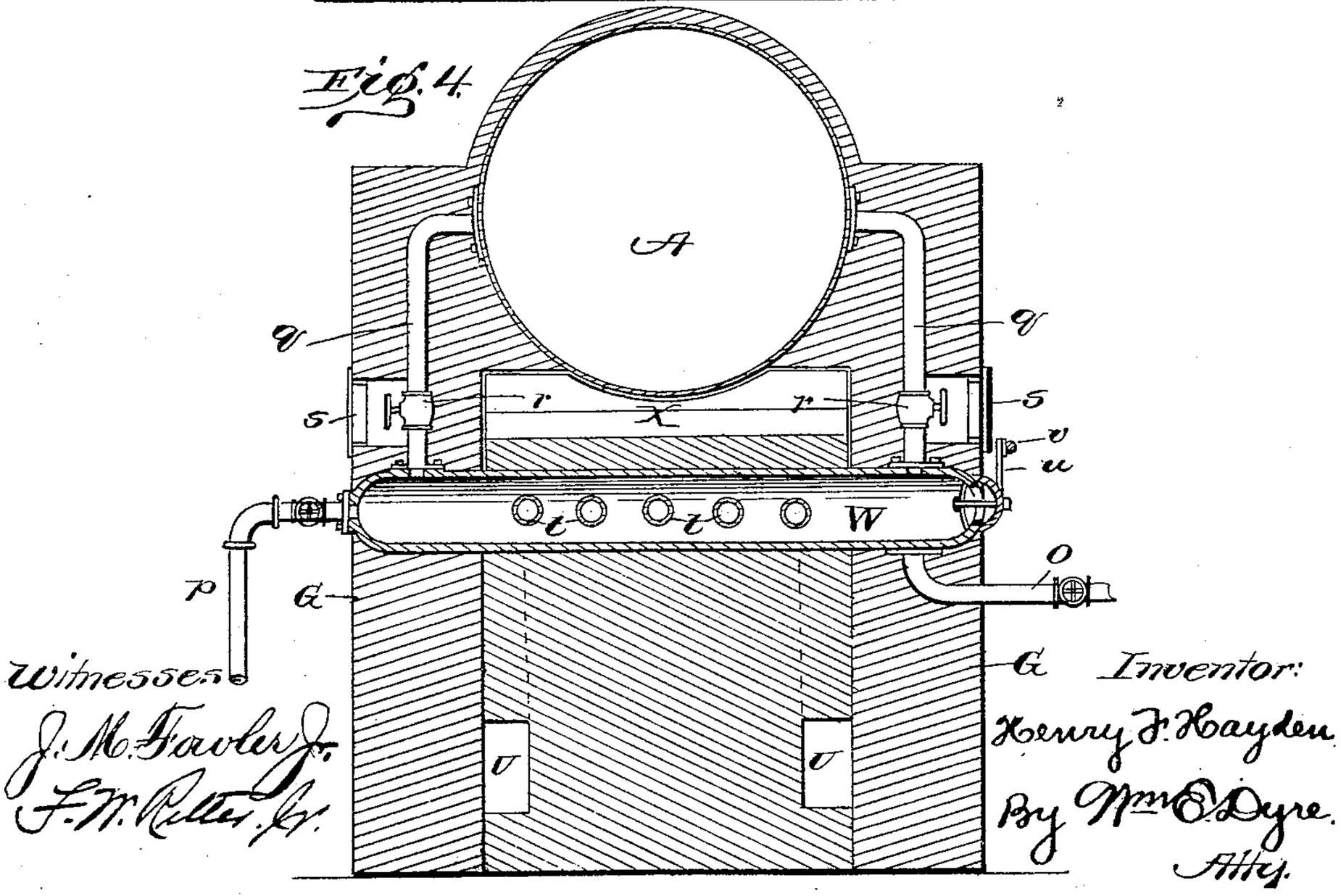


Fig. 4.



Witnesses:
J. M. Fowler Jr.
F. M. Keller Jr.

Inventor:
Henry F. Hayden
By Wm. E. Dyre.
Atty.

No. 704,325. Patented July 8, 1902.

H. F. HAYDEN.

SMOKE PREVENTING FURNACE.

(Application filed Dec. 14, 1900. Renewed Apr. 19, 1902.)

(No Model.) 3 Sheets—Sheet 2.

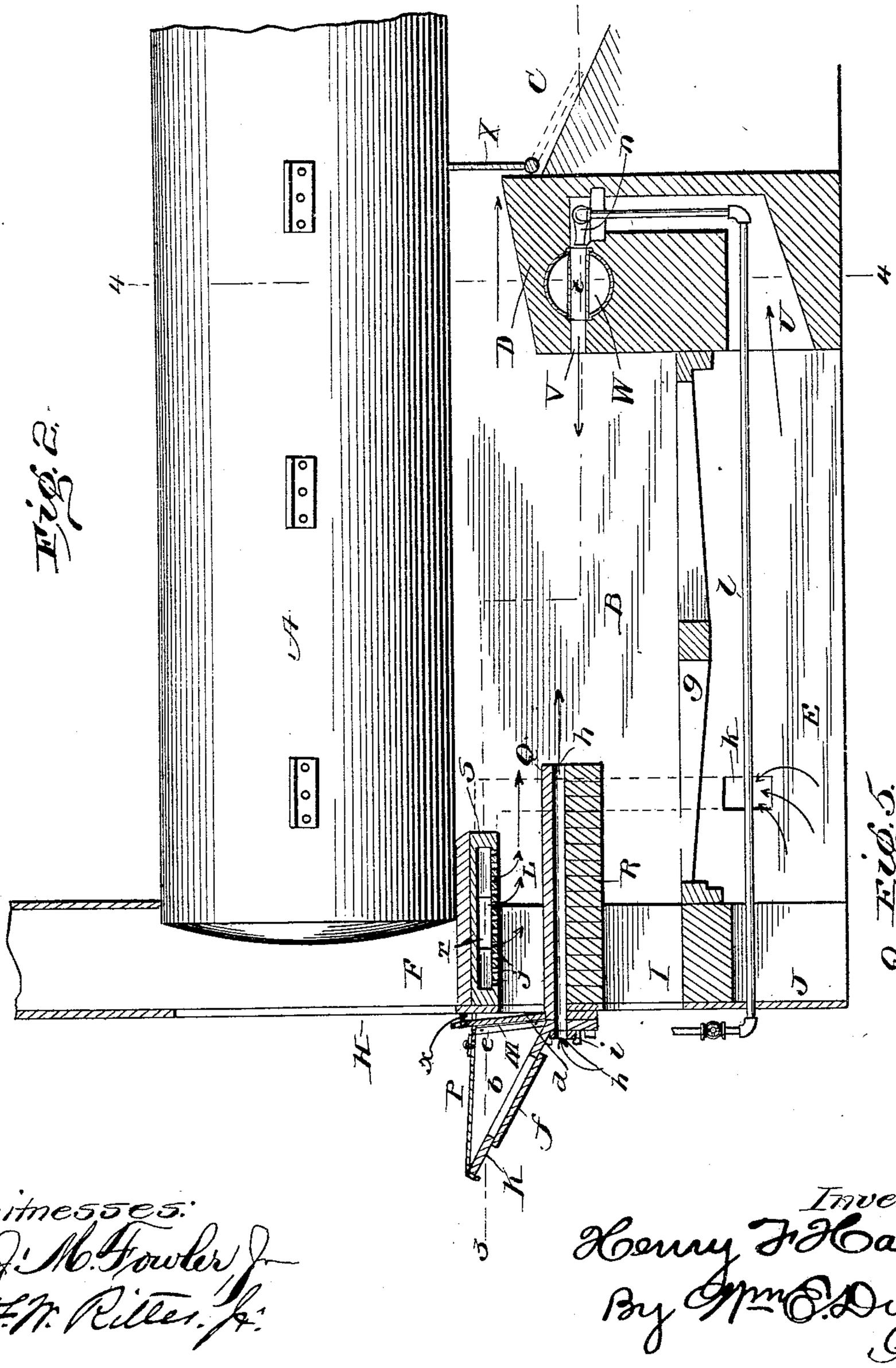


Fig. 2.

Fig. 5.

Witnesses:
J. M. Fowler Jr.
F. M. Riley Jr.

Inventor
Henry F. Hayden
By Wm. C. Dyre.
Atty.

No. 704,325. Patented July 8, 1902.

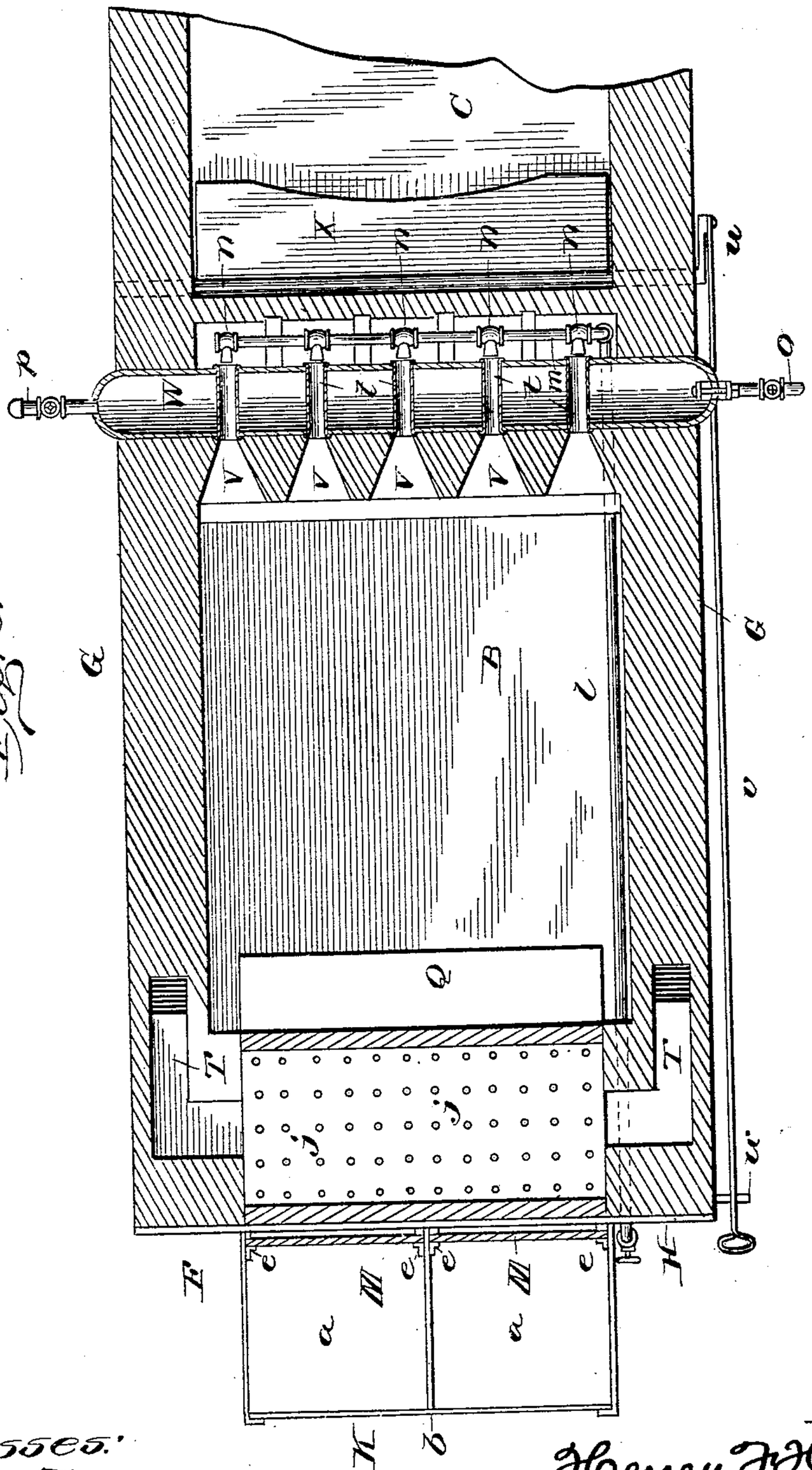
H. F. HAYDEN.

SMOKE PREVENTING FURNACE.

(Application filed Dec. 14, 1900. Renewed Apr. 19, 1902.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 3.



Witnesses:
J. M. Fowler Jr.
F. W. Ritter. Jr.

Inventor
Henry F. Hayden.
By Wm. O. Dyre.
Atty.

UNITED STATES PATENT OFFICE.

HENRY F. HAYDEN, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR OF ONE-THIRD TO JAMES HENRY JENNINGS, OF WASHINGTON, DISTRICT OF COLUMBIA.

SMOKE-PREVENTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 704,325, dated July 8, 1902.

Application filed December 14, 1900. Renewed April 19, 1902. Serial No. 103,761. (No model.)

To all whom it may concern:

Be it known that I, HENRY F. HAYDEN, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Smoke-Preventing Furnaces; 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.

My invention relates to boiler-furnaces such as employed in generating steam for driving stationary or portable engines and for other purposes.

More particularly stated the invention resides in certain peculiarities of construction and novel arrangement of parts whereby a maximum amount of heat is produced with a minimum expenditure of fuel, be it anthracite or bituminous coal, petroleum, or other combustible materials.

The chief objects of my invention are therefore to secure in furnaces a most thorough and complete combustion of all gases, to prevent the formation of smoke or, as commonly expressed, to "consume" it, and also to increase the general efficiency or steam-producing qualities of boilers heated by furnaces embodying my invention. In the practical accomplishment of these several objects the leading features of construction may be said to embrace means for feeding fuel to furnaces after having first partially coked same, means for supplying air in predetermined and suitable proportions to commingle and burn with the furnace-gases, as also for beating down or retarding in fire-chambers the traveling unconsumed products of combustion until same have been entirely consumed.

Additional features of my invention which contribute to the successful results obtained and constitute elements in the organized arrangement of parts, hereinafter more fully described, are a damper located between the bridge-wall of furnaces and the boiler, being there pivotally mounted in the side walls, a damper-rod for manipulating such damper from in front of the furnace, and a feed-water heater located in the bridge-wall and perforated by air-tubes, forming part of the air-feeding apparatus, all as will hereinafter be more fully set forth, and particularly pointed out in the claims.

In the accompanying drawings, which form part of this specification, and whereon corresponding letters indicate like parts in the several views, Figure 1 represents a furnace in front elevation embodying certain features of my invention relating to means for feeding fuel to the furnace. Fig. 2 is a longitudinal central section through the furnace with its rear chamber only partly shown. Fig. 3 is a horizontal section below the boiler on the line 3 3 of Fig. 2. Fig. 4 is a transverse vertical section taken on the line 4 4 of Fig. 2, and Fig. 5 is an end view of the coking-plate.

Reference being had to the drawings and letters thereon, A indicates a boiler of any form or construction, same being shown herein merely for the purpose of illustrating its relative position.

B indicates the fire-chamber; C, the rear chamber; D, the bridge-wall; E, the ash-pit, and F G G the front and side walls, respectively, of the furnace.

The metallic furnace-front H, which faces front wall F, is provided with the usual furnace and ash-pit doors I J, respectively arranged in pairs, and above these is attached a coal-feeding hopper K, which, in conjunction with a coking-oven L, constitutes an important feature of this invention. Hopper K is by preference formed of boiler-iron in two compartments *a a*, separated by a vertical partition *b* and bolted to boiler-front H through flanges *c* in register with mouth *d* of the oven L aforesaid. This hopper K, adjacent to its point of attachment, is provided with vertically-movable doors M M, guarding the outlet from each compartment *a* and sliding in guideways *e*, riveted to the hopper, each of said dampers being counterbalanced by weights N at the outer ends of interposed levers O O. (Shown by Fig. 1.) The top of hopper K is covered by a hinged lid P, while the angular bottom is provided with a pair of hinged stoke-hole doors *f f* for purposes that will later appear. Passing through the

mouth *d* of oven L is a rectangular coking-plate Q, which projects into the fire-chamber B, overhangs the grate-bars *g*, is corrugated or ribbed on its under surface, as at *h*, and is supported upon an arch R, of fire-brick, above the furnace-doors I I, as shown. At its outer edge said plate and the corrugations or channels *h* thereunder are fitted with a sliding perforated register-plate *i* for the purpose of controlling admission of air to and through said channels. Above oven L and supported in the front wall F, which it overhangs on the inside, is a rectangular air-chamber S, preferably of cast metal, having a perforated bottom *j*, communicating at its ends with air-ducts T, located in the side walls G G of the furnace and terminating at *k k* in the ash-pit E, said hopper, coking-oven, and air-ducts, all for purposes which will be hereinafter set forth in a statement of operation.

Opening into the bridge-wall D from ash-pit E are converging hot-air passages U, which extending upward in a vertical direction communicate with individual flattened diverging ports V, adapted to discharge heated air into fire-chamber B for reversing the natural draft of the furnace and retarding the traveling products of combustion in said chamber until they are thoroughly consumed. Running longitudinally through one side of the ash-pit E is a valved steam-pipe *l* in communication with boiler A or other source of steam-supply. This pipe *l*, passing through one passage U', communicates with a transverse delivery-pipe *m*, the latter being fitted with a series of injector-nozzles *n* in register with ports V for the purpose of compelling at times a flow of hot air through said ports by injecting therethrough highly-heated steam under pressure.

Near the upper edge in bridge-wall D is embedded a cylindrical feed-water heater W, fitted with a valved water-supply pipe *o*, and at its opposite end with a valved discharge-pipe or blow-out *p* for cleansing the heater of sediment that may accumulate therein. Extending upward from heater W are pipes *q q*, each provided with a valve *r*, operated through suitable hand-holes *s* in side walls G for the purpose of supplying hot water from the feed-water heater W to boiler A as occasion demands. Passing directly through heater W is a horizontal series of short tubes *t* in alinement with the nozzles *n* and ports V aforesaid, through which hot air from the ash-pit and passages U is driven the more effectually to heat the feed-water before its introduction into the boiler.

Immediately back of bridge-wall D is pivotally mounted in side walls G G a damper X in controllable communication with the front of the furnace by agency of a short crank *u* and a damper-rod *v*. This rod *v*, at its front end, is provided with suitably-spaced notches (not shown) for engaging a latch *w*, projecting from the side of the furnace as one means of graduating to a certainty the relative positions of damper X, which when not in use rests in a depressed position upon the foundation of rear combustion-chamber C, as shown by Fig. 3, entirely out of the line of draft and the direct heat of the furnace. When, however, damper X is in its most elevated position, it serves to practically close the space between bridge-wall D and boiler A, thus temporarily obstructing the line of draft and positively preventing the escape of smoke or unconsumed products. This most elevated position of damper X, however, is only resorted to when found necessary to fire directly through the furnace-doors or for other reasons the doors I I are opened, which is rarely the case. At such times, however, the superabundant supply of oxygen invariably results in an oversupply of gases, which are ordinarily forced up the furnace-stack and wasted; but in the present instance these are arrested in fire-chamber B and consumed after the doors I are closed.

Having thus described the preferred construction and organized arrangement of parts which constitute my invention, I will now proceed to describe in a general way its use and operation. At the outstart it will be understood that boiler-furnaces of this type are usually designed for the consumption of bituminous coal, and in the selection of materials from which my furnaces are built I by no means limit myself to those herein specified. Neither am I confined to the precise location and arrangement of the novel features of invention herein shown and described, being governed in such particulars by surrounding conditions, and especially so when my improvements are placed in old or previously-existing furnaces.

Presuming the furnace to have been duly fired and that it becomes necessary to add fuel, lid P is temporarily raised and coal thrown into compartments *a a* of hopper K, whereupon doors M M are elevated successively, the charges of coal being delivered into oven L by means of a suitable stoking implement. (Not shown.) Such implement is manipulated through the comparatively small hopper-doors *f f*, thus avoiding undue inrush of cold air and the necessity of opening the main furnace-doors I with the consequent disastrous results. Plate Q, extending into fire-chamber B, is moderately heated by the furnace-fire below, so that all fuel resting thereon is partially coked before its introduction to the grates. From the heated boiler-front H a limited supply of air is admitted to oven L through the slight opening to be seen at *x*, Fig. 2, and at same time another supply is similarly conducted thereto from ash-pit E by way of side passages T T and air-chamber S, the degree of heated air thus admitted to chamber S being regulated by the relative position of the ash-pit doors

J J and special demands made upon the heating system. Under these conditions the fuel is allowed to remain in oven L until thoroughly heated, the lighter gases being thus expelled and commingled with the heated air as it enters the coking-oven by way of opening *x* and the numerous perforations *j* in chamber S. As the enriched gases emerge from the coking-oven they are met by currents of air from channels *h* in the under surface of plate Q, which supply more or less oxygen according to requirements, and being met by incandescent particles rising from the furnace-fire are ignited and immediately converted into flame on the line of draft through the furnace. Fuel is thus repeatedly transferred from oven L to the fire-chamber B by the alternate processes of feeding, coking, and firing according to requirements of the system, as hereinbefore set forth. If necessary to bank the fire, a charge of coal is left upon the coking-plate Q, and as a consequence when again the fire is spread the furnace is readily charged with fuel in a highly-heated state, which contains no smoke-producing gases or moisture. When, as is rarely the case, furnace-doors I are opened or by any means there is a superabundant inrush of oxygenized air to the fire-chamber B, there the draft, and consequently waste unconsumed products of combustion, may be arrested in whole or in part by manipulation of damper X. Obviously this damper may be momentarily raised to the position indicated by Fig. 2 at any time a furnace door or doors I are opened with the result of holding in the fire-chamber all smoke gases which invariably form under such conditions until the door is again closed and the gases consumed. At times of excessive firing more particularly the draft-reversing apparatus located in bridge-wall D is called into requisition. Superheated steam from nozzles *n* is injected into and through each tube *t*, intersecting the feed-water heater W. This produces a blast of highly-heated air from ash-pit E, through said tubes *t* and their respective flattened converging ports V, in an unbroken sheet above the burning fuel and toward the furnace-doors. Thus the combustible gases in fire-chamber B are again met by a blast of heated air, which serves to arrest them in said chamber and with which they are thoroughly mixed, ignited, and burned. This passage of superheated steam and hot air through the transversely-arranged tubes *t* of heater W assists materially in heating the feed-water contained therein and at same time renders possible the most advantageous location of both heater W and ports V in the bridge-wall D of the furnace. Further than this the operation of heater W is well understood and requires no description.

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

1. In a furnace for preventing the formation of smoke the combination with a fire-chamber, of a coking-oven comprising an inwardly-projecting coking-plate, a series of air-channels beneath said plate, a superimposed perforated air-chamber, and suitable passages for conducting to said chamber an air-supply, substantially as described.

2. In a furnace for preventing the formation of smoke the combination with a fire-chamber, of a coking-oven located in the front wall thereof comprising an inwardly-projecting coking-plate, a series of air-channels beneath said plate, a register for closing said channels, a superimposed perforated air-chamber, and suitable passages for conducting to said chamber an air-supply, substantially as described.

3. In a furnace for preventing the formation of smoke the combination with a fire-chamber and ash-pit, of a coking-oven located in the front wall thereof comprising a coking-plate, a superimposed perforated air-chamber, and suitable passages communicating with said chamber at its ends for conducting thereto an air-supply directly from the ash-pit of the furnace, substantially as described.

4. In a furnace for preventing the formation of smoke the combination with a coking-oven, of a hopper for feeding said oven, a partition dividing said hopper into compartments, and a sliding door set at an angle to the furnace-front for controlling the discharge of each compartment, substantially as described.

5. In a furnace for preventing the formation of smoke the combination with a coking-oven, of a hopper for feeding said oven, a partition dividing said hopper into compartments, a sliding door set at an angle to the furnace-front for controlling the discharge of each compartment, a lid for the top of said hopper, and stoke-hole doors in its bottom, substantially as described.

6. In a furnace for preventing the formation of smoke the combination with a fire-chamber, ash-pit and bridge-wall, of an air-duct entering said bridge-wall from the ash-pit and terminating in a plurality of diverging flattened ports for introducing heated air into the fire-chamber above the fire to reverse the natural draft thereof, substantially as described.

7. In a furnace for preventing the formation of smoke the combination with a fire-chamber, ash-pit and bridge-wall, of an air-duct entering said bridge-wall from the ash-pit, a plurality of diverging ports communicating with said duct and directed into the fire-chamber, and a series of injector-nozzles for forcing a draft of air through said duct and ports, substantially as described.

8. In a furnace for preventing the formation of smoke the combination with a fire-chamber, ash-pit and bridge-wall, of a feed-water heater in said bridge-wall fitted with a

series of transverse tubes, an air-duct entering the bridge-wall from the ash-pit, a plurality of diverging ports communicating with said duct through the tubes aforesaid in the feed-water heater, and suitable injector-nozzles for forcing air through said duct, tubes and ports, substantially as described.

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

HENRY F. HAYDEN.

Witnesses:
ALEXANDER S. STEUART,
WM. E. DYRE.