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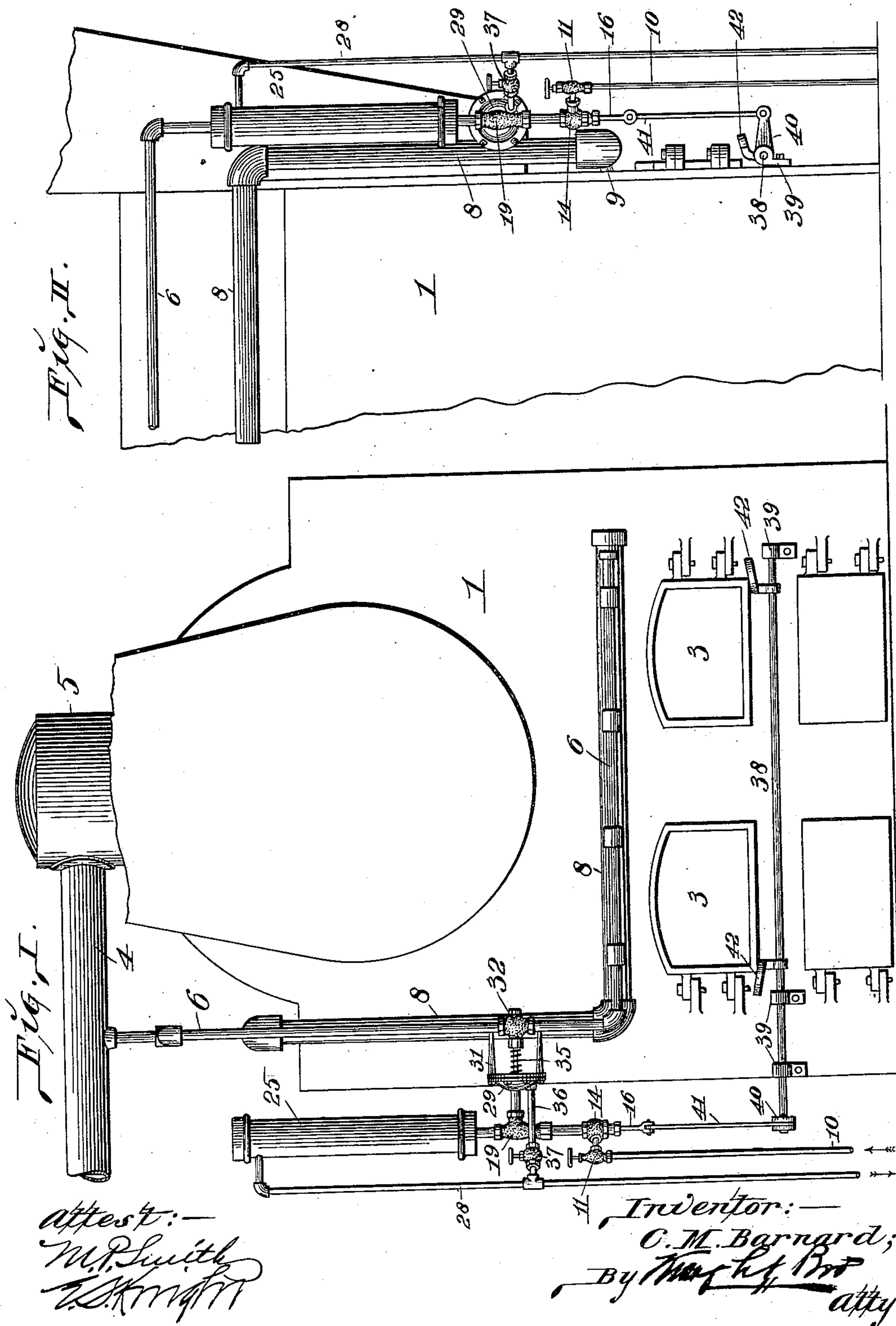
Patented May 20, 1902.

C. M. BARNARD.
SMOKE CONSUMING FURNACE.

(Application filed Dec. 12, 1901.)

2 Sheets—Sheet 1.

(No Model.)



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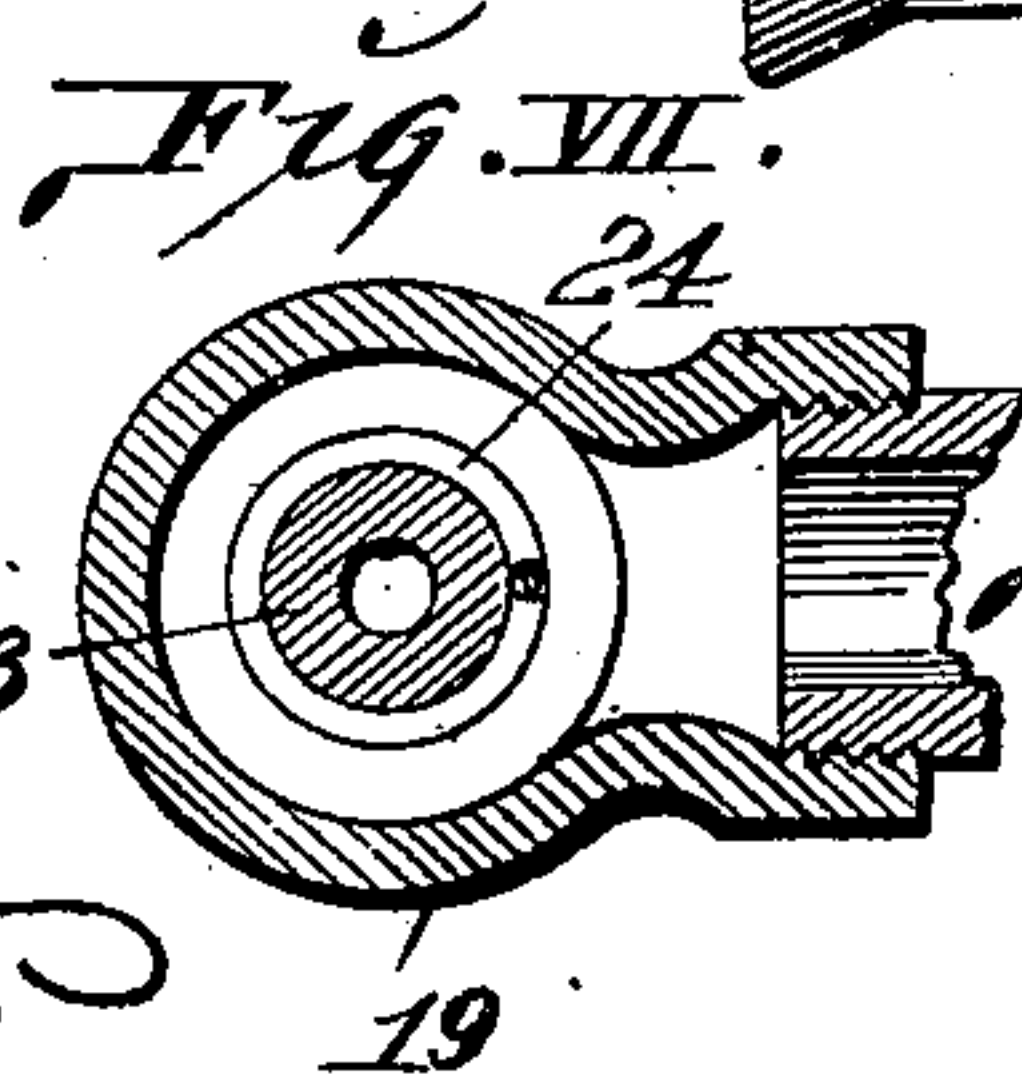
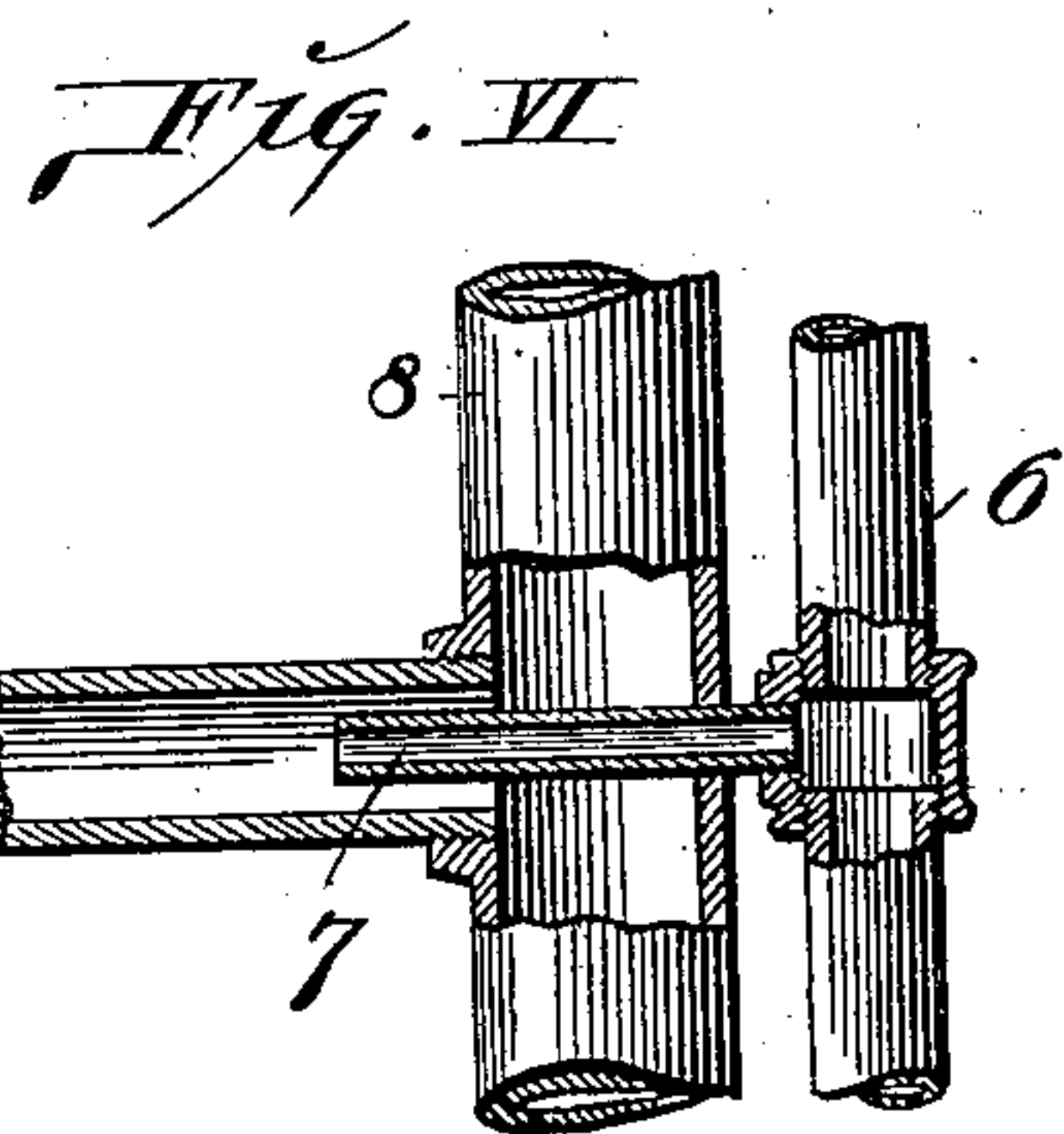
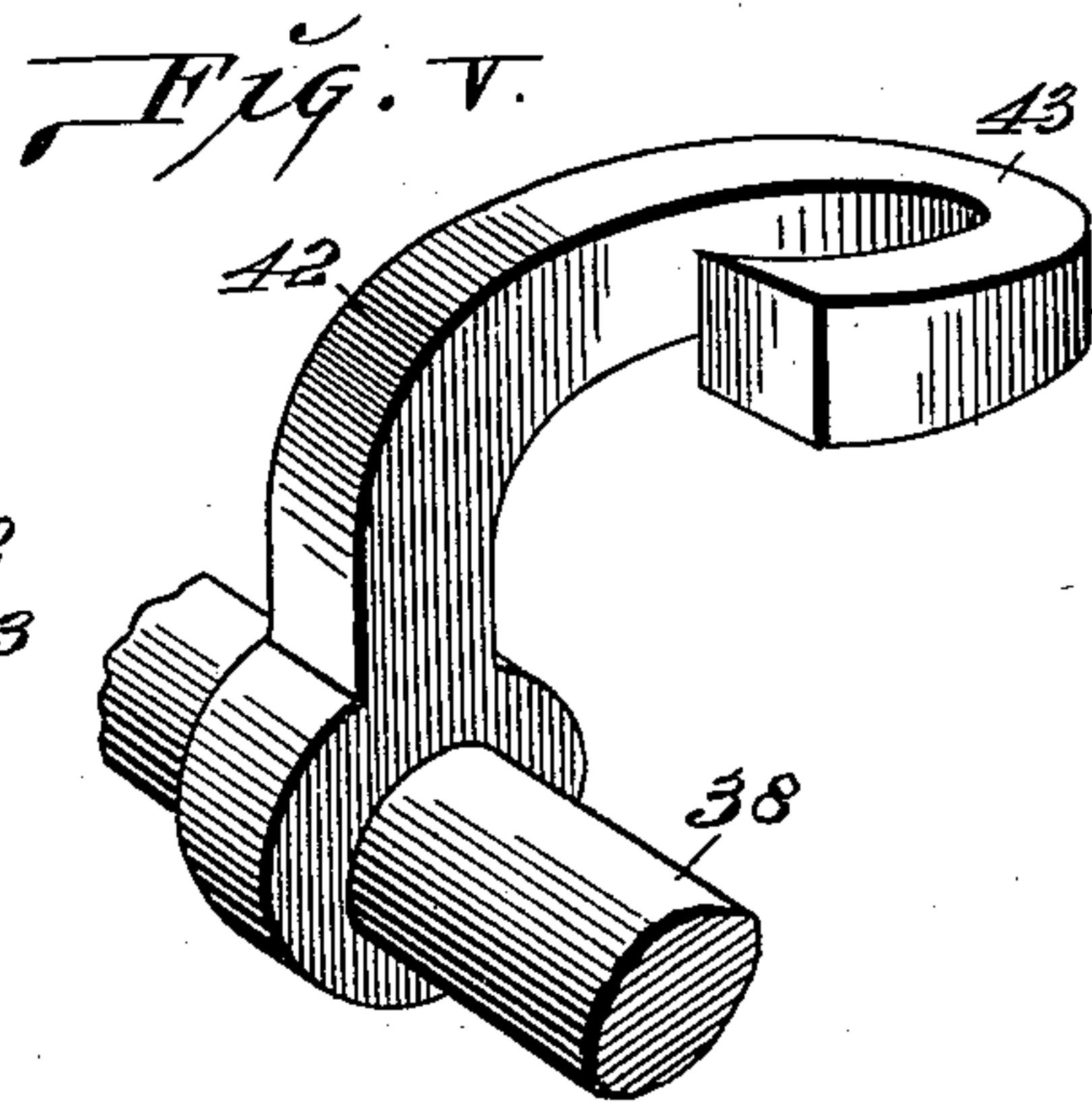
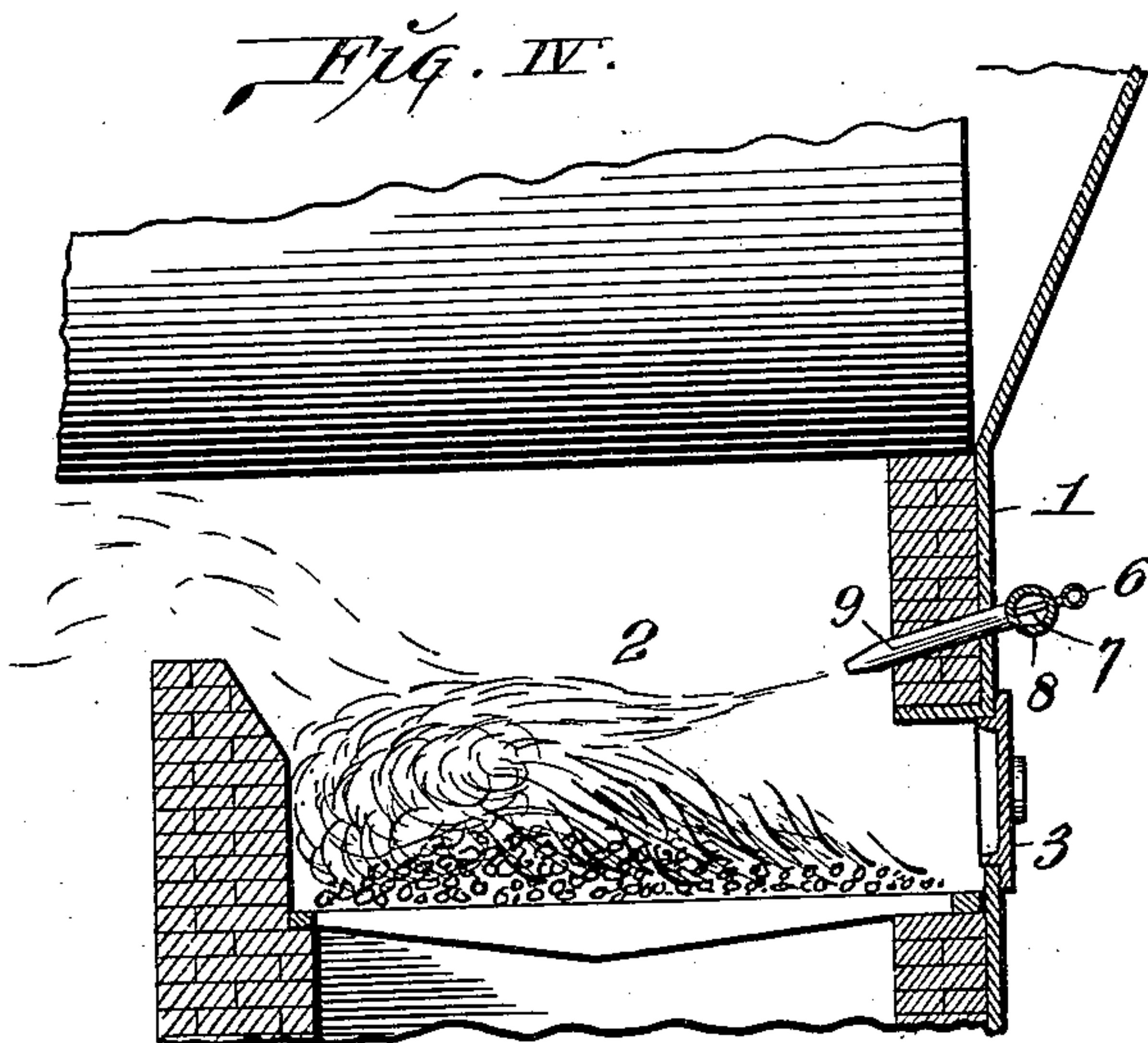
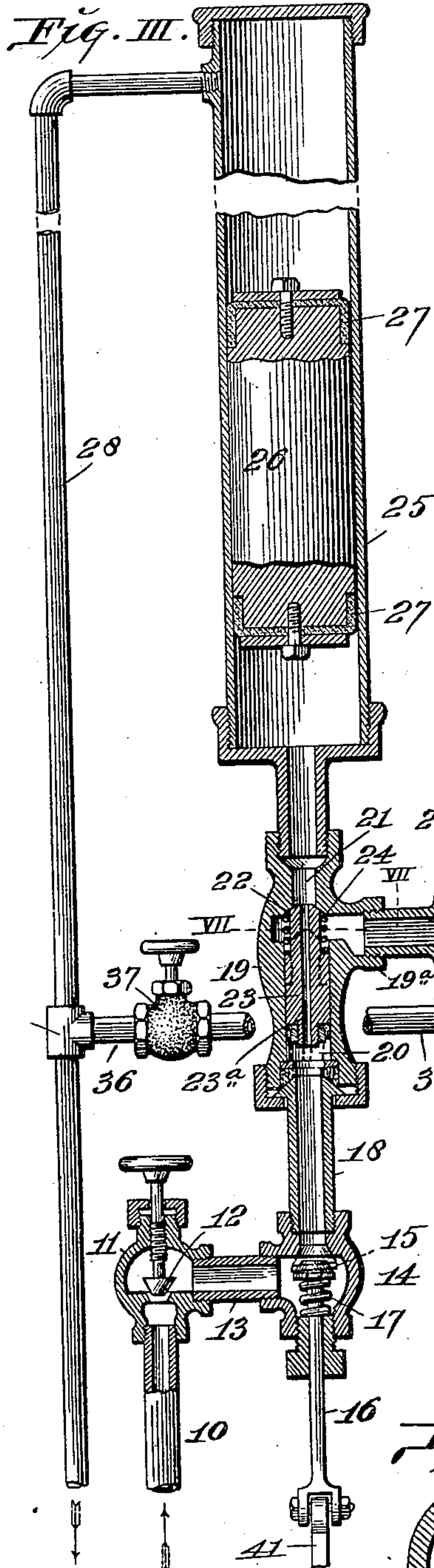
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2 Sheets—Sheet 2.

(No Model.)



attest:—
W. Smith
E. Smith

Inventor:—
C. M. Barnard;
By Wright, Burt
attys.

UNITED STATES PATENT OFFICE.

CHARLES M. BARNARD, OF ST. LOUIS, MISSOURI, ASSIGNOR OF ONE-FOURTH
TO MAURITIUS GRUBER, OF ST. LOUIS, MISSOURI.

SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 700,605, dated May 20, 1902.

Application filed December 12, 1901. Serial No. 85,598. (No model.)

To all whom it may concern:

Be it known that I, CHARLES M. BARNARD, a citizen of the United States, residing in the city of St. Louis, in the State of Missouri, have
5 invented certain new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.
10

My invention relates to that class of smoke-consuming furnaces in which jets of steam are injected into the fire-chamber of a furnace to mingle with the smoke rising from the fuel
15 in said chamber.

The invention, briefly stated, embodies means whereby a supply of water is admitted into a receiving-cylinder on the opening of the furnace-doors for the purpose of firing the
20 furnace and which provides for the exertion of pressure by said water on the closing of the furnace-doors to actuate a steam-pipe valve and effect the injection of steam into the fire-chamber of the furnace for an interim
25 succeeding the closing of the furnace-doors.

My invention consists in features of novelty hereinafter fully described, and pointed out in the claims.

Figure I is a view in front elevation of a furnace constructed in accordance with my invention. Fig. II is a side view of the front end of the furnace. Fig. III is an enlarged vertical sectional view of the water-pressure-valve-actuating apparatus of the furnace.
30 Fig. IV is a vertical sectional view of a furnace fire-box. Fig. V is an enlarged detail perspective view of one of the rock-shaft arms operated by the furnace-doors. Fig. VI is a detail view, partly in section, of the steam
35 and air injecting pipes. Fig. VII is an enlarged cross-sectional view taken on line VII VII, Fig. III.

1 designates a furnace containing a combustion-chamber 2 and of any desirable construction.
45

3 designates the furnace-doors.

4 designates a steam-pipe that preferably leads from the dome 5 of the steam-boiler mounted in the furnace 1. Connected to the
50 steam-pipe 4 is the steam-conveying pipe 6, that leads downwardly and across the front

of the furnace and has attached to it the injection-tubes 7. (See Fig. VI.)

8 designates an air-pipe that preferably extends from a position at the top of the furnace, at which point it is open to receive the admission of air that is constantly maintained in heated condition above the furnace. This air-pipe extends downwardly and across the front of the furnace in a parallel line with
55 the steam-pipe 6, at which location the injection-tubes 7, attached to the steam-pipe, are introduced through said air-pipe, as seen in Fig. VI.
60

9 designates jet-tubes seated in the air-pipe 8 and extending therefrom into the combustion-chamber 2 (see Fig. IV) and into which the injection-tubes 7 extend to draw the air by suction through the air-pipe and force it in a jet with the steam delivered from the injection-tubes into the combustion-chamber.
65 70

10 designates a water-supply pipe leading from a suitable source of supply into a valve-housing 11, that contains a regulating-valve 12, adapted to be set in a position to control, as found desirable, the quantity of water passing through said housing 11 from the supply-pipe 10. The valve-housing 11 is connected by a pipe 13 to a valve-housing 14, containing a cut-off valve 15, that is carried
75 80 by a stem 16 and normally held to its seat in said housing by a spring 17. Above the valve-housing 14 is a pipe 18, that leads to a valve-housing 19, provided with a vertical valve-chamber 20 and duct 21, the latter of which extends above a valve-seat 22.
85

23 is a tubular valve reciprocally positioned in the valve-chamber 20 and surrounded by a spring 24, the utility of which will be hereinafter mentioned.
90

25 designates a pressure-cylinder located above the valve-housing 19 and having communication with the duct 21 in said valve-housing. In the pressure-cylinder 25 is a reciprocatory plunger 26, provided at each
95 end with a cup-packing 27.

28 is a drain or air-escape pipe connected to the upper end of the pressure-cylinder 25.

Projecting laterally from the valve-housing 19 is a neck 19^a, that receives the connection of a diaphragm-housing 29, in which is seated a diaphragm 30, the housing and dia-
100

phragm constituting a pressure-motor adapted to receive the exertion of water-pressure that is permitted to enter said diaphragm-housing from the valve-housing 19. The diaphragm-housing 29 is attached to the steam-pipe 6 of the apparatus by pins 31. In the steam-pipe 6 opposite the diaphragm-housing and diaphragm mounted therein is a valve-housing 32, (see Figs. I and III,) which may be of the detail construction shown in Fig. III or of any other desirable form. Mounted in the valve-housing 32 is a valve 33, that is carried by a stem 34, attached to the diaphragm 30 and surrounded by a spring 35, by which the valve is normally held to its seat.

36 is a drain-pipe leading from the valve-housing 29 to the exhaust-port 28 and provided with a regulating-valve 37, by which the flow of water through said exhaust-port from the diaphragm-housing may be controlled.

38 designates a rock-shaft mounted in brackets 39 on the front end of the furnace 1, the said rock-shaft being united to the stem 16 of the cut-off valve 15 by a crank-arm 40, fixed to the rock-shaft, and a connecting-rod 41, pivotally connected to said crank-arm and said valve-stem 16. On the rock-shaft 38 in proximity to each furnace-door 3 are cam-arms 42, that extend vertically from said rock-shaft and then laterally and in upwardly and outwardly inclined directions, as seen in Figs. I and II. These cam-arms 42 are preferably bent into the form of a hook 43 at their ends, as seen in Fig. V, in order to provide a wide bearing-surface, onto which the furnace-doors may be swung and travel when opened.

In the practical use of the smoke-consuming apparatus herein described the parts operate in the following manner: On the opening of a furnace-door 3 the rock-shaft 38 is rotated in its bearings by reason of the door moving onto the cam-arm 42 beside it and rocking said cam-arm, upon which action a pull is exerted upon the connecting-rod 41 and valve-stem 16 to unseat the cut-off valve 15 and permit water to flow from the supply-pipe 10 past the regulating-valve 12 into the valve-housing 14 and therethrough past the cut-off valve. The water then ascends through pipe 18 into the valve-housing 19, and its pressure acts against the reciprocatory valve 23 to elevate said valve to the valve-seat 22, thereby closing communication between the duct 21 and the diaphragm-housing 29. The reciprocatory valve 23 is normally held in lowered position by the spring 24; but its elevation by the pressure of water is rendered possible by reason of the restricted passage-way 23^a in said valve, which restricts the flow of water and provides for the existence of a pressure-receiving surface at the lower end of the valve, against which the water may act to elevate and hold the valve. The water on passing through the valve 23 flows through the duct 21 and up into the pressure-cylinder 25, in which it acts to elevate the recipro-

tory plunger 26, carrying said plunger to the upper end of said pressure-cylinder. The passage of the water to the pressure-cylinder should properly consume a space of time corresponding to the time required for the introduction of coal through the furnace-doorway into the fire-chamber, so that the pressure-cylinder will be filled with water beneath the reciprocatory plunger 26 and the plunger be thereby moved to the upper end of the pressure-cylinder. The rapidity of water-flow to effect this result is controlled by the setting of the regulating-valve 12. On the closing of the furnace-door subsequent to firing the furnace the cut-off valve 15 is returned to its seat by the spring 17, surrounding the stem of said valve, and the rock-shaft 38 is returned to normal position. On the seating of the cut-off valve pressure is relieved from the reciprocatory valve 23, thereby permitting said valve to be returned to its lower position by the spring 24 and opening communication from the duct 21 through the valve-housing neck 19 to the diaphragm-housing 29. The reciprocatory plunger 26 at this time exerts a downward pressure within the pressure-cylinder 25 upon the water therein, forcing said water from the cylinder into the diaphragm-housing 29 to exert pressure against the diaphragm 30, and thereby unseat the valve 33 and permitting the passage of steam through the valve-housing 32, from which the steam passes to the injection-tubes 7 to be injected therefrom through the jet-tubes 9 into the furnace with the air drawn into the air-pipe 8 thereby. This action continues until the water has been exhausted from the pressure-cylinder by passing into the diaphragm-housing and therefrom through the exhaust-port 36 to the drain-pipe 28 for discharge, subsequent to which the diaphragm 30 is returned to its normal position by the spring 35 on the valve-stem 34, thereby causing a cessation of the flow of steam through the pipe 6. The rapidity of flow of water into and from the diaphragm-housing is regulated at will by the adjustment of the regulating-valve 37 to cause the water to flow more or less rapidly through the exhaust-port 36.

I claim as my invention—

1. In combination with a furnace, a steam-pipe adapted to deliver steam to the combustion-chamber of said furnace, a normally closed valve in the steam-pipe, a pressure-motor for opening said valve provided with a constantly open exhaust-port, a reservoir having an inlet for fluid under pressure and an outlet in communication with the valve-motor, a door for the furnace and means set into operation by the opening of said door for bringing into communication, the inlet and the reservoir and cutting off communication between the reservoir and the pressure-motor and by the closing of the door for cutting off communication between the inlet and the reservoir and providing communication between the latter and the pressure-motor.

2. In combination with a furnace, a steam-pipe adapted to deliver steam to the combustion-chamber, of said furnace, a normally closed valve in the steam-pipe, a pressure-motor for opening said valve provided with a constantly open exhaust-port, a reservoir having an inlet for fluid under pressure and an outlet in communication with the valve-motor, a reciprocating valve, a door for the furnace and means controlled by the opening of the door for moving said valve in one direction to bring into communication said inlet and said reservoir and cut off communication between said reservoir and said pressure-motor, and by the closing of the door for moving said valve in the opposite direction to open communication between the reservoir and the pressure-motor and cut off communication between the inlet and said reservoir.

3. In combination with a furnace, a steam-pipe adapted to deliver steam to the combustion-chamber of said furnace, a valve-stem, a normally closed valve in the steam-pipe and carried by said stem on one end thereof, a diaphragm within a suitable housing and secured to the other end of said stem, and adapted to open said valve, a constantly open exhaust-port in said housing, a reservoir having an inlet for fluid under pressure, and an outlet in communication with said housing, a door for the furnace and means set into operation by the opening of said door for bringing into communication the inlet and the reservoir

and cutting off communication between the reservoir and the housing, and by the closing of the door for cutting off communication between the inlet and the reservoir, and providing communication between the reservoir and the housing.

4. In combination with a furnace, a steam-pipe adapted to deliver steam to the combustion-chamber of said furnace, a normally closed valve in the steam-pipe, a pressure-motor for opening said valve provided with a constantly open exhaust-port, a reservoir having an inlet for fluid under pressure and an outlet in communication with the valve-motor, pressure-controlled means for bringing into communication said inlet and reservoir and cutting off communication between the reservoir and the pressure-motor, when water is admitted to said inlet and cutting off communication between said inlet and the reservoir and providing communication between the reservoir and the pressure-motor when water is cut off from said inlet, a valve for controlling admission of water to said inlet, a rock-shaft connected to said valve and cam-arms carried by said shaft, in line with the outward swing of the furnace-doors.

In testimony whereof I have hereunto set my hand this 15th day of December, 1901.

CHARLES M. BARNARD.

In presence of—

E. D. KNIGHT,
M. P. SMITH.