No. 786,243. PATENTED MAR. 28, 1905.

J. B. BARRETT.

METHOD OF PRODUCING COMPLETE COMBUSTION OF FUELS.

APPLICATION FILED MAY 28, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

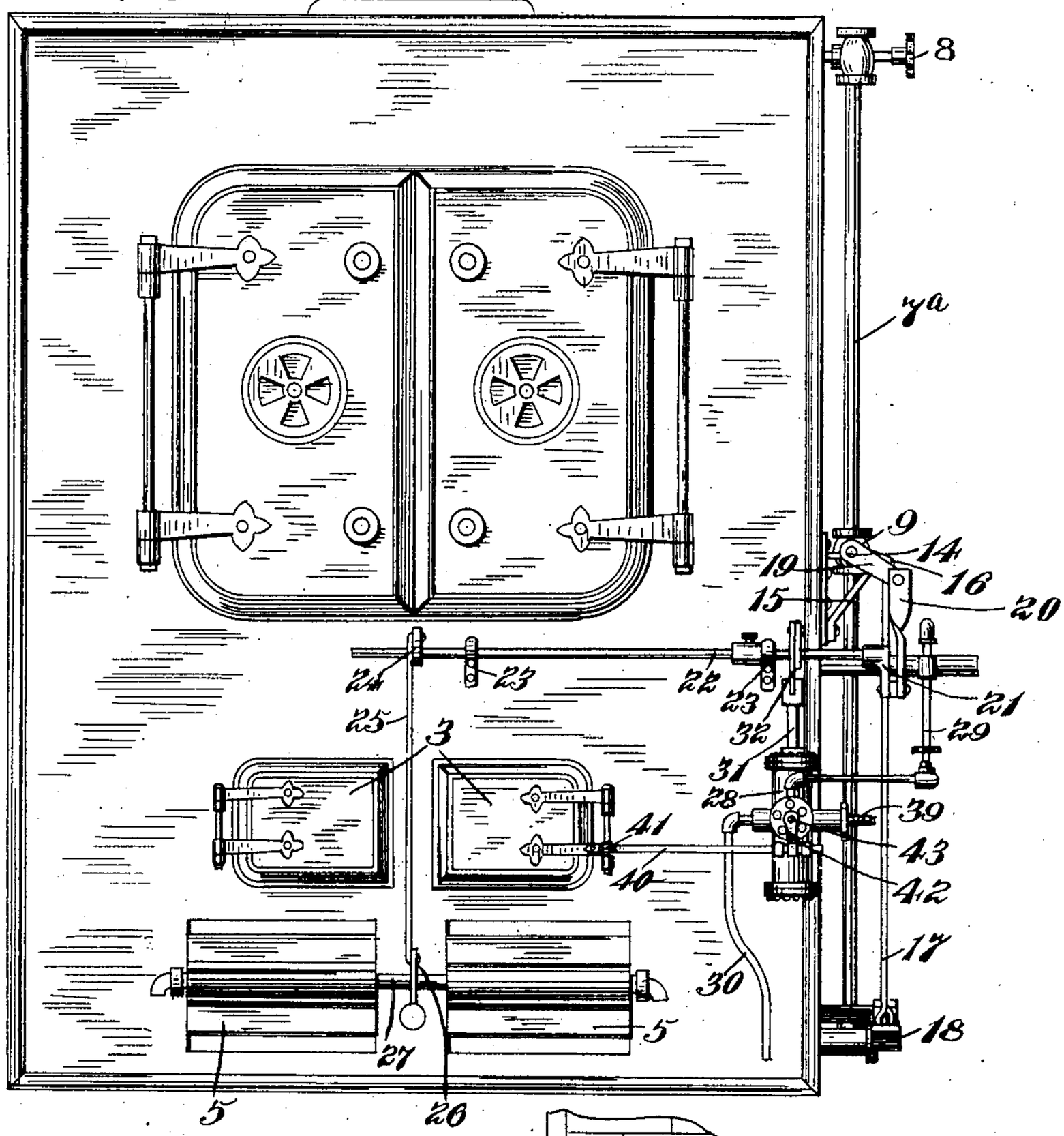
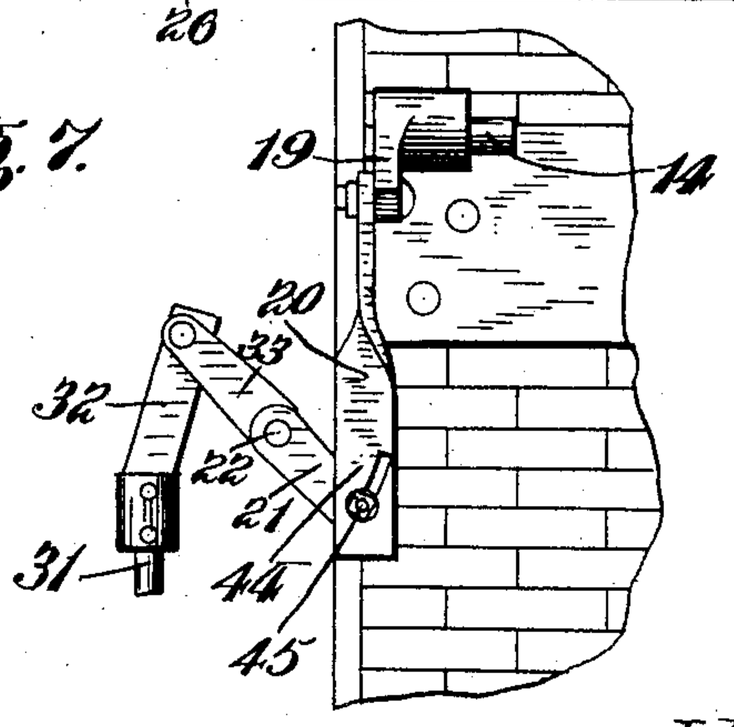


Fig. 7.



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3 SHEETS—SHEET 2.

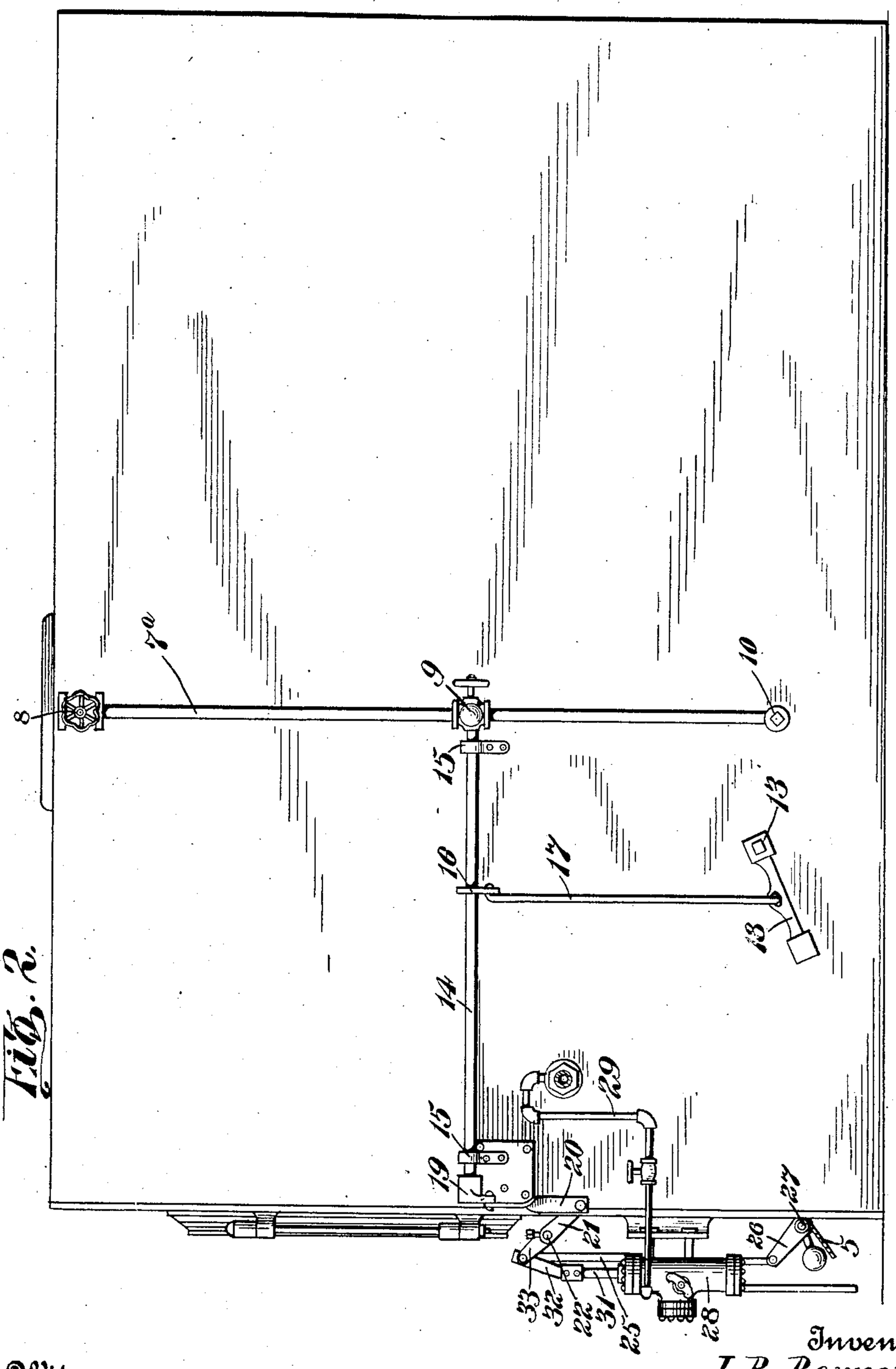

Fig. 2.

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3 SHEETS—SHEET 3.

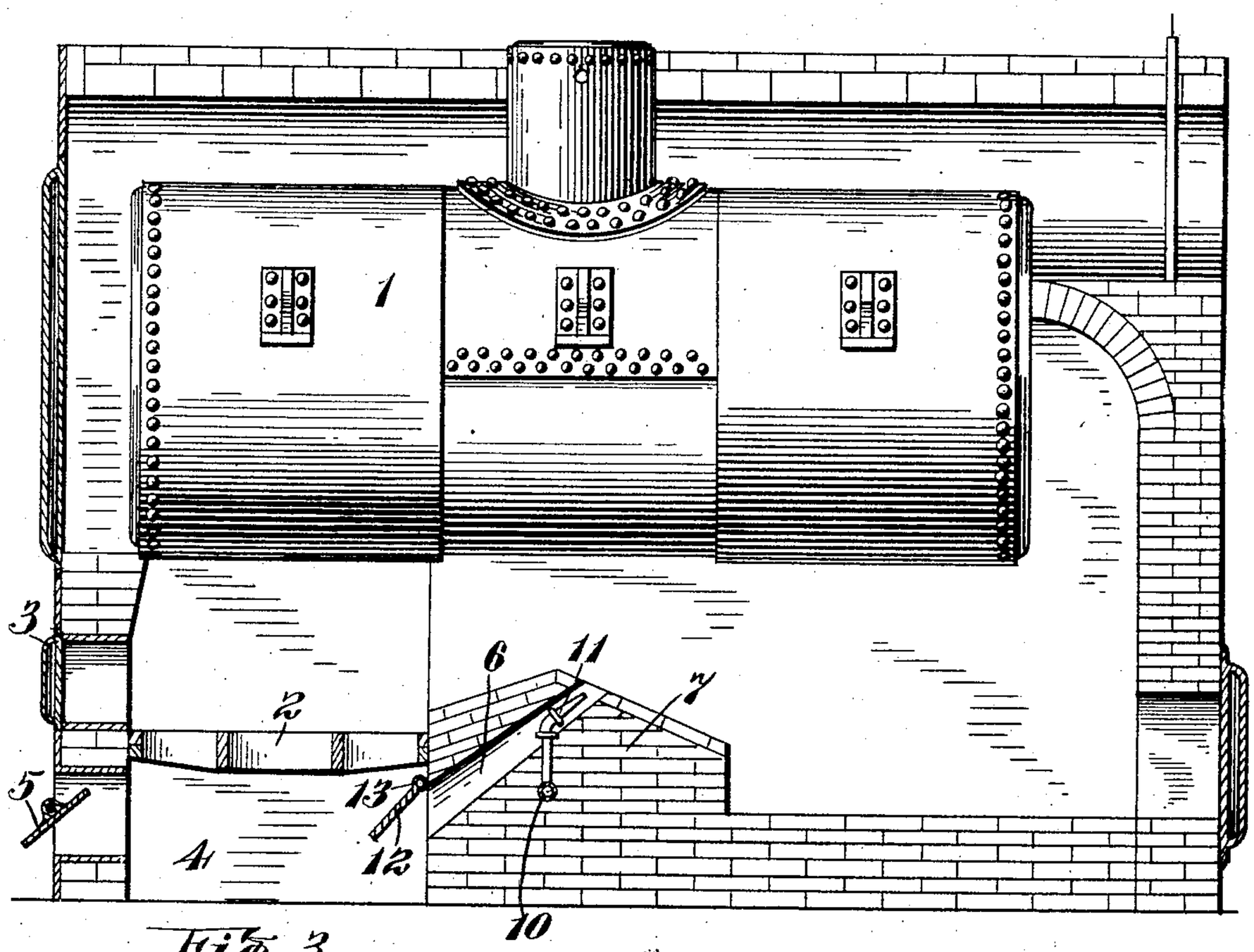

Fig. 3.

Fig. 4.

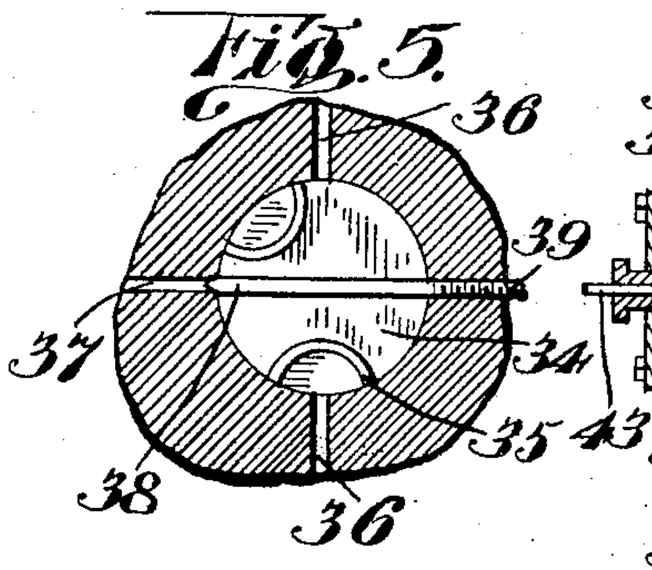

Fig. 5.

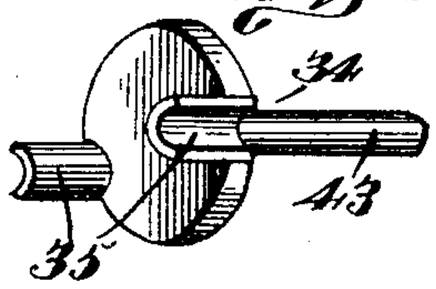

Fig. 6.

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UNITED STATES PATENT OFFICE.

JAMES B. BARRETT, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO INTERNATIONAL BOILER IMPROVEMENT COMPANY, OF PIERRE, SOUTH DAKOTA, A CORPORATION OF SOUTH DAKOTA.

METHOD OF PRODUCING COMPLETE COMBUSTION OF FUELS.

SPECIFICATION forming part of Letters Patent No. 786,243, dated March 28, 1905.

Application filed May 28, 1904. Serial No. 210,289.

To all whom it may concern:

Be it known that I, JAMES B. BARRETT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Methods of Producing Complete Combustion of Fuels, of which the following is a specification.

My invention relates to a smoke-consumer and fuel-economizer for furnaces; and it consists in the steps and process herein described and claimed.

The objects of my invention are to provide a method of operation in which complete combustion of fuel will be obtained by means of partial combustion thereof at separate predetermined points, whereby a long and substantially uniform flame will be produced, which is especially adapted for steam-boiler furnaces and in which the extent or degree of combustion can be regulated entirely independently of the rate of combustion.

A further object of my invention is to provide a method for preventing the escape of smoke from the furnace during the operation of firing.

Referring to the accompanying drawings, forming a part of this application, and in which similar reference-symbols indicate corresponding parts in the several views, Figure 1 is a front end elevation, illustrating one means for carrying out my invention applied to the furnace of a stationary boiler. Fig. 2 is a side elevation thereof. Fig. 3 is a longitudinal sectional elevation of the construction shown in Fig. 1. Fig. 4 is an axial sectional view illustrating one form of regulator employed in my invention. Fig. 5 is a detail sectional view, on a larger scale, on the line 5 5 of Fig. 4. Fig. 6 is a detail perspective view showing the regulator-valve, and Fig. 7 is a detail side elevation illustrating a slightly-modified form of link connection to the side rod.

Referring especially to Figs. 1, 2, and 3 of the drawings, 1 indicates a return tubular boiler suitably mounted and provided with the usual grate-bars 2 and fire-doors 3. The ash-pit 4 is shown provided with swinging doors 5 and connected by a plurality of air-conduits 6 with a space behind the bridge-wall 7, said conduits being preferably arranged to discharge along the path of the products of combustion adjacent thereto. A pipe 7^a, provided with valves 8 and 9, conducts steam from any suitable portion of the boiler to a cross-pipe 10, which latter is shown embedded in the bridge-wall and provided with a nozzle 11, arranged substantially axially in each of said air-conduits near its discharge end. The entrance end of each air-conduit is controlled by a damper or door 12, the several doors being shown secured to a common actuating-rod 13. A side bar 14 is journaled in suitable supports 15 in position to actuate the steam-valve 9 and carries a crank 16, operatively connected to the common actuating-rod 13, as by a rod 17, and weighted lever 18, secured to the rod 13. A crank 19 on the side bar 14 is connected by a link 20 to a crank 21 on a front rod 22, which latter is suitably journaled at 23. A crank 24 on the front rod is shown connected by a link 25 to a crank 26 on a common pivotal support 27 of the ash-pit doors 5. A fluid-actuated regulator 28 is shown connected by an inlet-pipe 29 with any suitable source of motive fluid, such as the boiler feed-pipe, and with an exhaust-pipe 30. The piston-rod 31 of such regulator is connected by a link 32 to a crank 33 on the front rod 22 for actuating the latter upon movement of said piston. An oscillating disk valve 34, carrying channeled extensions 35, is shown positioned for controlling the admission-ports 36 and exhaust-ports 37 of the regulator, (see especially Figs. 4, 5, and 6,) and a regulating-valve 38 is provided with a threaded stem 39 to permit its adjustment for varying the size of the exhaust-port orifice, and thereby controlling the rate of movement of the variator-piston. A pitman-rod 40 is shown pivotally connected at 41 to one of the fire-doors 3 and suitably engaging a crank 42 on the spindle 43 of the variator-valve 34 for actuating said valve upon movement of the fire-door.

In the operation of my invention the parts

are suitably arranged to permit admission to the conduits 6 of the proper proportions of air and steam for normal running. The steam-valve 8 is then preferably closed and a fire built on the grate-bars in the usual manner. After the steam-pressure generated in the boiler has been raised sufficiently to produce an efficient action of the steam jets or nozzles 11 the valve 8 is opened, thus admitting steam to such nozzles. It will be noted that prior to the generation of steam in the boiler a portion of air will be drawn through the conduits 6 by the natural draft of the furnace and will tend to complete the combustion of the products of combustion flowing over the bridge-wall and that after sufficient steam-pressure has been generated in the boiler to produce an efficient action of the jets 11 an increased amount of air will be drawn through the conduits 6 by the injector action of said jets, and the desired amount of properly-proportioned mixture of air and steam for producing perfect combustion will be discharged into the products of combustion flowing past the discharge end of the conduits.

It will be noted that no metal parts are subjected to the direct action of the hot products of combustion, but that the steam-nozzles 11 are maintained at a high temperature by the heat transmitted through the walls of the air-conduits 6. By thus imparting heat to the steam during its expansion, all condensation incident to adiabatic expansion is prevented and the velocity of flow of the steam is materially increased, thereby providing a strong injector action with a minimum consumption of steam. Further, by thus previously superheating the steam it will be more readily decomposed into its constituent hydrogen and oxygen upon admixture with the hot products of combustion. The oxygen furnished by the air and steam discharged from the conduits 6 will unite with the products of incomplete combustion, such as carbonic oxid, and the hydrogen furnished by the decomposed steam will unite partly with the oxygen and partly with the products of incomplete combustion to produce water and hydrocarbons, which last will probably subsequently combine with oxygen, thus insuring complete combustion of the fuel.

In the above-described normal operation of the furnace the fire-doors 3 are closed and the valve 34 is shifted by the pitman-rod 40 in position to maintain the piston-rod 31 of the variator in its upper position, as clearly shown in Figs. 1 and 4. When it is desired to fire the furnace, the door 3, which carries the pitman 40, is first opened, thereby shifting the valve 34 into position for causing the descent of the piston-rod 31 to its lowest position. Such descent of the piston-rod will swing the front rod 22 in its bearings sufficiently to close the ash-pit doors and through the connection of said front rod to the side bar 14 will actuate the steam-valve 9 and the damper 12, thereby augmenting the amount of air and steam discharged through the conduits 6 and correspondingly increasing the force of the draft. In this position of the parts with the ash-pit doors closed the injector action of the steam-jet 11 will produce a sufficient reduction of pressure in the ash-pit 4 to draw the cold air entering through the open fire-doors 3 downward into said ash-pit through the bed of fuel supported on the grate-bars. This causes the furnace to act on the downdraft principle and insures complete combustion of the products of combustion in their passage through the lower layers of incandescent fuel on the grate-bars and in the subsequent intimate admixture of the hot air and gases discharged from the conduits. This method of drawing through the bed of incandescent material the cold air entering the fire-doors during the operation of firing is an important part of my invention and eliminates the troublesome escape of smoke through the furnace-stack occasioned in previous constructions of smoke-consumers by the inrush of cold air through the open fire-doors over the relatively cool layers of recently-fired fuel during the operation of firing. After sufficient fuel has been charged into the furnace in the operation of firing the fire-doors 3 are closed, thereby shifting the variator-valve into position to elevate and maintain the variator piston-rod 31 in its upper position, whereupon the front rod 22 will be actuated to open the ash-pit doors and to suitably adjust the dampers 12 and steam-valve 9 for the normal operation of the furnace.

Under certain practical conditions of running it is desirable that the steam-valve 9 and the dampers 12 shall remain at their maximum degree of opening for a short period after the fire-doors are closed before being adjusted to the positions assumed by them during the normal operation of the furnace. For this purpose the variator is provided with an adjustable regulating-valve 38, adapted to vary the size of the exhaust-port orifice, and thereby regulating the velocity of movement of the variator-piston. For example, the exhaust-port 37 of the variator may be sufficiently throttled by the regulating-valve 38 to require one minute for the movement of the variator-piston through its stroke, if desired. Any suitable means, such as adjustable stops carried by the variator-piston, may be employed for limiting the travel of said piston.

The dampers 12, which control the entrance-orifices of the conduit 6 in my construction, may be dispensed with by decreasing the area of said conduits, and such modified construction is especially adapted to certain practical conditions of operation — as, for example, those in which a thin bed of fuel is maintained on the grate-bars.

As shown in the drawings, the variator-

valve 34 is actuated from only one of the fire-doors, and in the operation of firing such fire-door is the first opened and the last closed; but it is obvious that the variator-valve could be operatively connected to both fire-doors, if desired.

I have illustrated a preferred means for carrying out my invention; but obviously many changes could be made, and any means capable of carrying out my improved method lies within the spirit and scope of my invention.

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

1. The herein-described method of producing complete combustion of fuels, which consists in passing a current of air through said fuels to cause incomplete combustion thereof, charging additional fresh fuel from time to time, reversing the direction of the current of air through the fuel during such charging operation, and intimately intermixing fluids capable of sustaining combustion with the hot products of incomplete combustion, substantially as described.

2. The herein-described method of producing complete combustion of fuels, which consists in passing a current of air through said fuels to cause incomplete combustion thereof, charging additional fresh fuel from time to time, reversing the direction of the current of air through the fuel during such charging operation, and intimately intermixing heated fluids capable of sustaining combustion with the hot products of incomplete combustion, substantially as described.

3. The herein-described method of producing complete combustion of fuels, which consists in passing a current of air through said fuels to cause incomplete combustion thereof, charging additional fresh fuel from time to time, reversing the direction of the current of air through the fuel during such charging operation, and intimately intermixing air and steam with the hot productions of incomplete combustion, substantially as described.

4. The herein-described method of producing complete combustion of fuels, which consists in passing a current of air through said fuels to cause incomplete combustion, charging additional fresh air from time to time, reversing the direction of the current of air through the fuel during such charging operation, and intimately intermixing heated air and steam with the hot products of incomplete combustion, substantially as described.

5. The herein-described method of producing complete combustion of fuels, which consists in passing a current of air through said fuels to cause incomplete combustion thereof, charging additional fresh fuel from time to time, reversing the direction of the current of air through the fuel during such charging operation, and intimately intermixing heated air and superheated steam with the hot products of incomplete combustion, substantially as described.

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

JAMES B. BARRETT.

Witnesses:
A. R. BENNETT,
W. B. HOLDER.