No. 745,757. PATENTED DEC. 1, 1903.

J. ARMSTRONG.

MECHANICAL FURNACE.

APPLICATION FILED DEC. 2, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

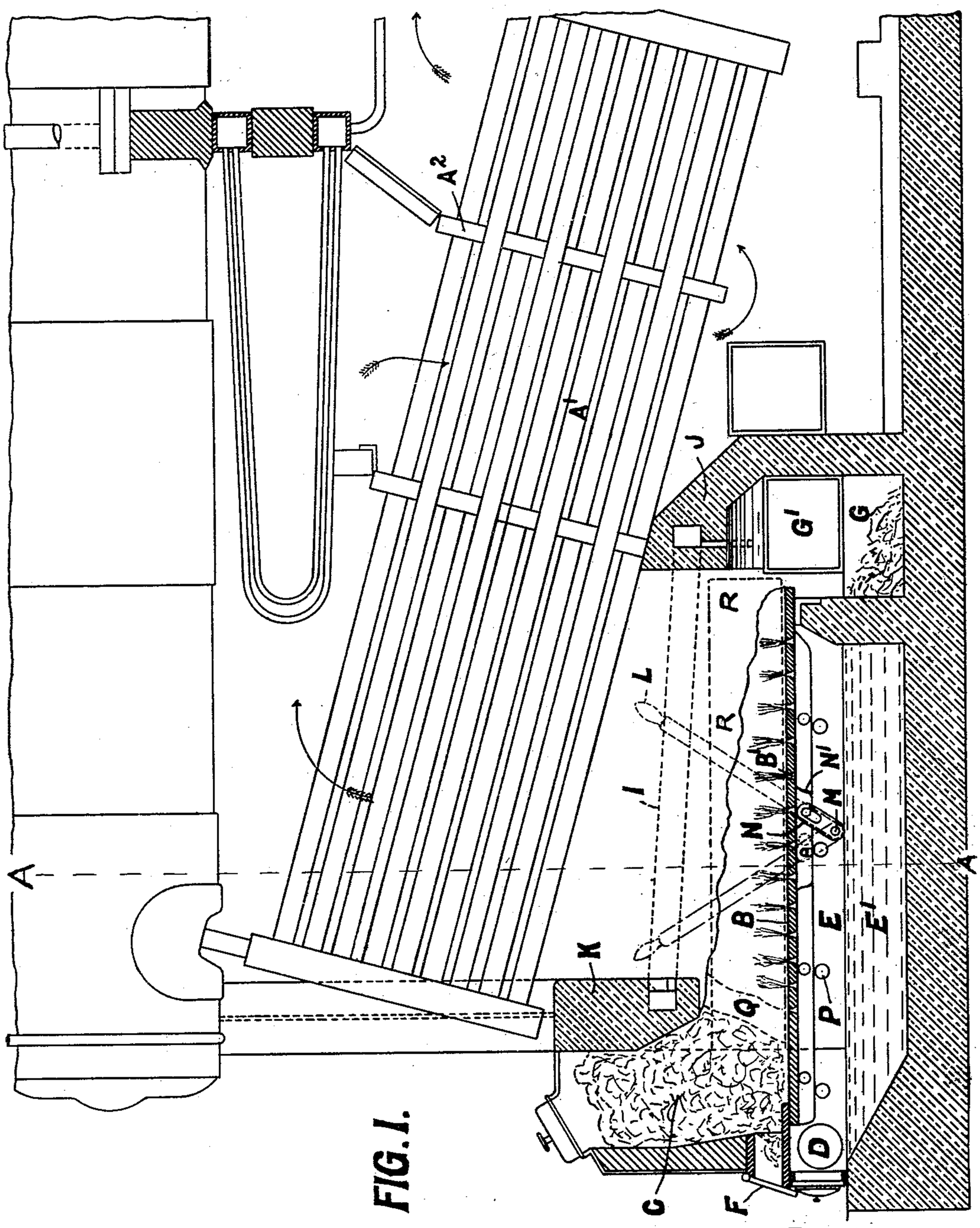


FIG. 1.

Witnesses.

J. Green

Wm. J. Hammond

Inventor

John Armstrong

By Knight Bros

Attys

No. 745,757. PATENTED DEC. 1, 1903.

J. ARMSTRONG.

MECHANICAL FURNACE.

APPLICATION FILED DEC. 2, 1902.

NO MODEL

4 SHEETS—SHEET 2.

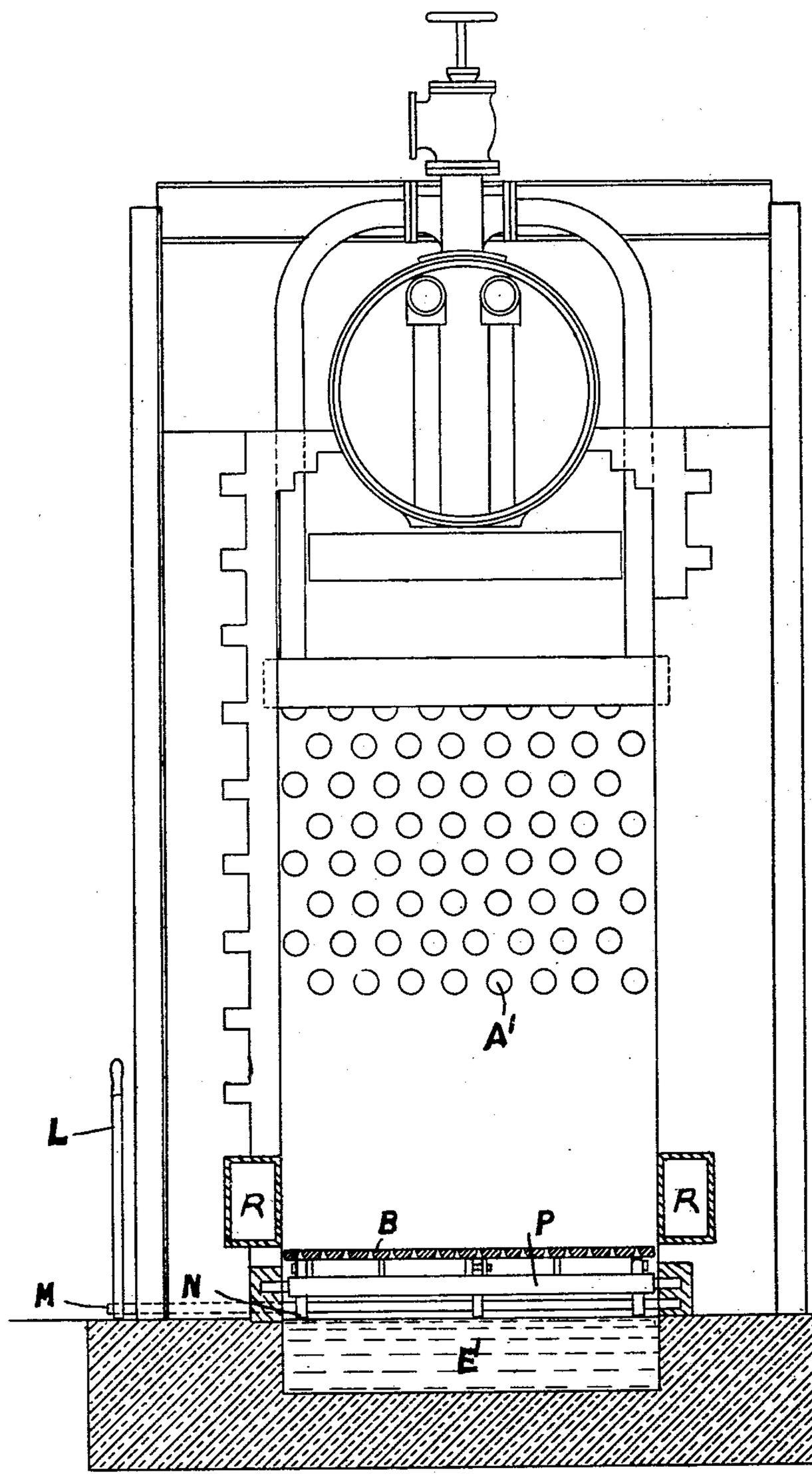


FIG. 2.

Witnesses.

J. Green

Wm. P. Hammond

Inventor.

John Armstrong

By Knight & Bro.

Attys.

No. 745,757. PATENTED DEC. 1, 1903.

J. ARMSTRONG.

MECHANICAL FURNACE.

APPLICATION FILED DEC. 2, 1902.

NO MODEL. 4 SHEETS—SHEET 3.

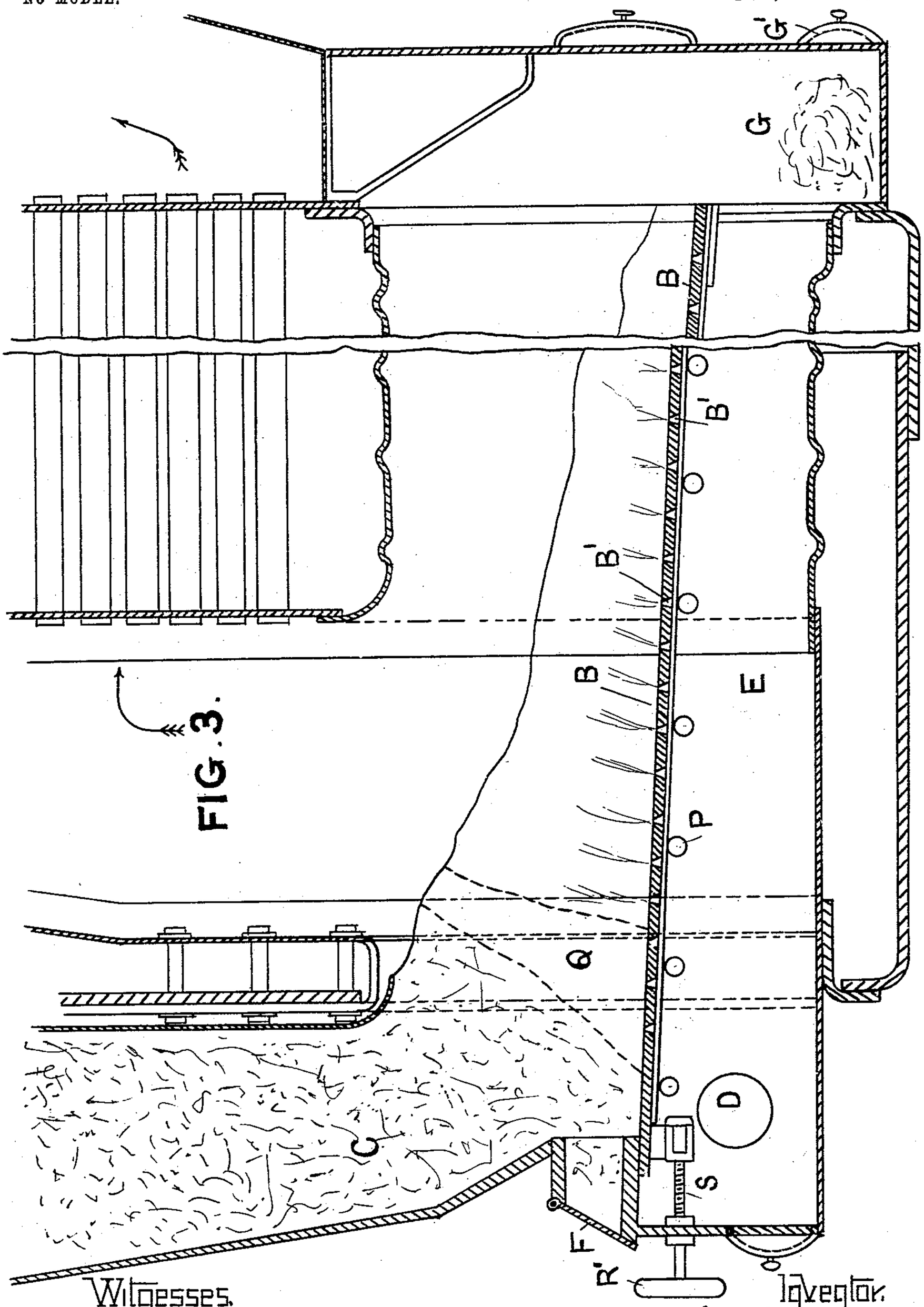


FIG. 3.

Witnesses.

J. Green

Wm. P. Hemmons

Inventor.

John Armstrong

By Knight Bros.

Attys.

No. 745,757.

PATENTED DEC. 1, 1903.

J. ARMSTRONG.

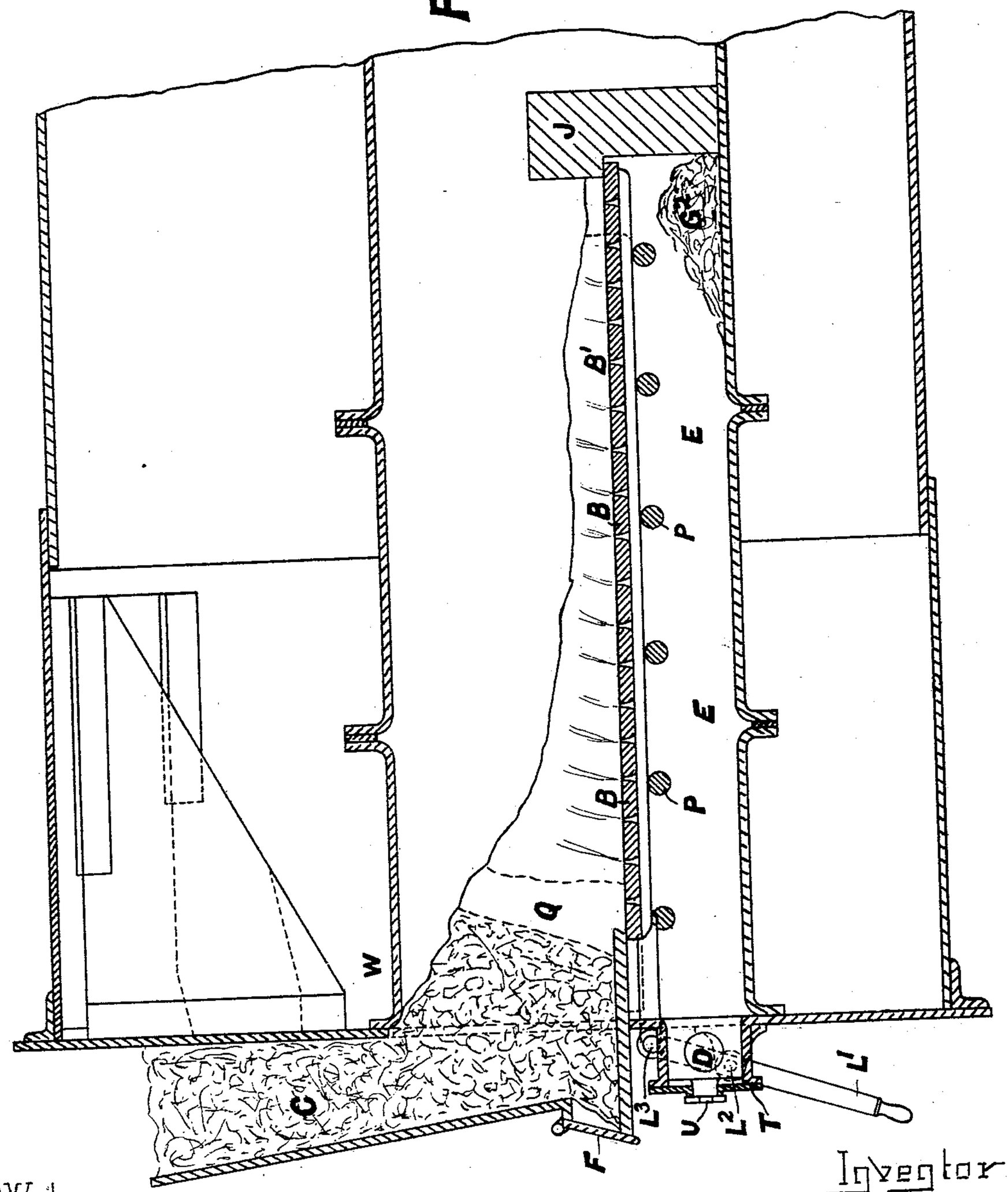
MECHANICAL FURNACE.

APPLICATION FILED DEC. 2, 1902.

NO MODEL.

4 SHEETS—SHEET 4

FIG. 4.



Witnesses

J. Green

Wm P. Hammond

Inventor

John Armstrong

By Knight Bros.

Attys.

No. 745,757. Patented December 1, 1903.

UNITED STATES PATENT OFFICE.

JOHN ARMSTRONG, OF LONDON, ENGLAND.

MECHANICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 745,757, dated December 1, 1903.

Application filed December 2, 1902. Serial No. 133,568. (No model.)

To all whom it may concern:

Be it known that I, JOHN ARMSTRONG, civil engineer, a subject of the King of Great Britain, residing in London, in the county of Middlesex, England, (whose full postal address is 46 Lombard street, London aforesaid,) have invented certain new and useful Improvements in Mechanical Furnaces, of which the following is a specification.

In marine boilers and water-tube boilers, especially at the present time, it has been found extremely difficult to prevent a very large amount of smoke, and mechanical stoking, especially in marine boilers, has hitherto been considered impracticable.

Now this invention is designed to automatically distribute the coal over the fire, to produce a uniform red-hot mass over the grate, and to automatically withdraw the clinker at the end, the sole action of the fireman being to keep the hopper full of fuel, to withdraw the clinker from time to time from the clinker-pit, and in some cases to actuate the grate. The reason why mechanical stoking and movable bars have quite failed in marine boilers where a forced draft is used is that the fire-bars are very quickly burned out. Now I have found in actual practice that I can get a white heat in my furnace and yet maintain a comparatively cold grate-surface, that I can produce an incandescent surface over the entire area of the furnace, and can remove the clinker without admission of air beyond that required to consume the gases.

The invention is best set forth by aid of the accompanying drawings, in which—

Figure 1 is a longitudinal section of my apparatus as applied to the ordinary Babcock boiler; Fig. 2, a transverse vertical section of the same through A A of Fig. 1; Fig. 3, a longitudinal vertical section showing my application to a marine boiler. Fig. 4 shows a longitudinal vertical section through a Lancashire boiler. It is obvious, however, that the invention can be equally applied to almost all other kinds of boilers, such as salt-pans, evaporators, reverberatory furnaces, kiln-furnaces, and, in fact, furnaces generally.

Referring first to Figs. 1 and 2, A′ represents the ordinary water-tubes; A^2, diaphragms causing the products of combustion to circulate, as set forth in the drawings. B is the furnace-hearth, formed of a plate of wrought or cast iron or steel, imperforate immediately below the hopper C, but otherwise having a large number of conical perforations B′ all over its surface to allow of the forced draft passing through it. C is a hopper of any desired height. If it be low, it is closed in with a lid or a shot-flask device, whereby fuel can be admitted without air passing through; but if the hopper be sufficiently high the fuel itself, which is preferably slack, forms a sufficient seal. D is the entrance for the forced blast into the chamber E, which latter is closed except for the conical passage through the grate. These are preferably about three-eighths to half an inch diameter at the top and three-quarters at the bottom. The lower part of this chamber E is preferably kept filled with water E′. F is a door forming a poke-hole into the furnace. G is a chamber at the end of the grate into which the clinker falls from time to time as the grate is drawn back, as hereinafter described. G′ is a door usually kept shut, but open from time to time to extract the clinker. I I represent a passage connected with the forced blast admitting air into the chamber G′ below and through the bridge J and also admitting air into the furnace through the bridge K. L is a handle, and M a spindle, to which the handle is keyed and which has a crank N, also keyed to it and pivoted to a flange N′, fixed to the lower surface of the grate. P P represent a series of rollers on which the grate runs. At each side of the grate and level therewith I place water-jackets R, so as to form a cool surface against which the fuel cannot stick. These are not required in the metallic flue of an inside-fired boiler, but are required in the case of water-tube boilers and in furnaces where the grate is surrounded by brickwork.

The mode of action is as follows: The fire being lighted, the hopper is filled with fuel and closed at the top if the height of the fuel itself will not act as a seal. After the fire has been burning a bit the blast is turned on at D. As the fuel on the furnace becomes burned the handle L is brought from the po-

sition shown in dotted lines to the position shown in chain dotted lines. This brings the entire grate forward—say six inches. A hiatus takes place, (shown in dotted lines at Q,) which is immediately filled by the fuel descending from the hopper. The handle L is now brought back to the position shown in ordinary dotted lines. As the hiatus Q is now filled with fuel, the fuel on the grate cannot retreat with the grate. Accordingly the clinker at the end falls over into the chamber G. Every now and then, either by hand or by power, the lever L or its equivalent is actuated in this way, and thus the fuel is gradually made to traverse forward to the end. I have found that when in working order the evaporation from the water below and the forced draft keeps the plate-grate so cold that a layer of one or two inches of ashes is always formed immediately over the grate and that above this layer molten clinker is formed and falls down as a porridge-like mass into the chamber G. The fuel on the imperforate portion of the grate is partially gasified and as it enters beyond the bridge K is incandescent. Consequently the entire surface of the fuel is brightly incandescent. The plate-grate differs in action completely from fire-bars, in that being so thin and perfectly smooth on top no clinker is ever formed on it, it being too cold for clinker to stick, and as a rule no clinker comes near it, as there is a bed of ashes generally below. In the case of bars, however, the surface is uneven, the ashes fall through too rapidly, the clinker comes upon the bars, and the bars are very quickly burned away. Where, however, the plate is thin and almost its whole under surface exposed to the forced blast, it remains cool.

In Fig. 3 a hand-wheel and screw R′ and S, respectively, take the place of the lever L of Figs. 1 and 2.

In Fig. 4 a heap of clinker G^2 is shown fallen over the end of the grate into ash-pit E, which latter is closed by the door T. In this latter is arranged a sight-hole U. The door-frame projects so that the air-inlet pipe D can enter at its side. The angle of the tube at W takes the place of bridge K, or, if desirable, a bridge, such as K, Fig. 1, can be added. The grate is rocked by lever L′, linked to it at L^3, and oscillating on fixed center L^2.

I have tried this invention in a reverberatory furnace and in boilers and find that except just when lighting no smoke ever appears in the chimney, though prior to applying my furnace dense masses of black smoke were always constantly present.

I declare that what I claim is—

1. In a furnace, the combination of a hopper forming a seal for the admission of air, a thin horizontal plate-grate perforated except immediately under the hopper, means for moving the grate horizontally in a backward and forward direction, a chamber below the grate and means for supplying a forced draft into this chamber, and for providing water in the chamber whereby the grate is kept continuously cool.

2. In a furnace, the combination of a hopper forming a seal against the admission of air, a thin plate-grate perforated except immediately under the hopper, means for moving the grate horizontally in a backward and forward direction, a dead-plate immediately overlapping the grate and a horizontal poker-hole immediately above the grate, substantially as described.

3. The combination of the hopper forming with its load of fuel a seal, a flat grate B, mechanism L for reciprocating the same, means for the free fall of clinker from the end of the grate when the grate is reciprocated forward, a closed chamber below the grate, means for supplying a forced draft and water into said closed chamber, the bridges J and K, and means for supplying further air through both the bridges J and K, substantially as described.

4. The combination of the flat plate-grate, means for reciprocating it in its entirety in a direction parallel to its surface, means for keeping a high pile of fuel above its front end, and a free discharge at the rear end of that grate whereby the fuel is fed into the furnace in masses, carried onward without disturbing the relative position of the pieces of the fuel till they are discharged at the end of the grate, while fresh fuel falls from the pile of fuel into the hiatus formed by the movement of the grate, and holds the remaining fuel, while the grate is being returned to its forward position.

5. The combination of a flat grate, means for reciprocating it in a direction parallel to its surface, means for keeping a high pile of fuel above its front end, a closed receptacle at the end of the grate, and a free discharge at the end of that grate into that receptacle whereby the fuel is fed into the furnace in masses and carried onward without disturbing the relative position of the pieces of the fuel till they are discharged at the end of the grate.

6. The combination of a hopper, a blast below the same open freely to the furnace, a substantially flat horizontal plate-grate imperforate below the hopper, but perforated beyond, means for giving the entire grate a horizontal reciprocating motion, and a chamber below the end of the grate into which the clinker falls, whereby the entire contents of the furnace on the perforated grate are passed on together, leaving a hiatus into which the fuel from the hopper descends.

7. The combination of the flat perforated grate-plate forming the entire grate, means for reciprocating the same in a direction parallel with the grate-surface, a closed chamber below, a forced draft into the said cham-

ber, means for feeding the fuel onto the grate at one end in masses at each onward reciprocation, and means for freely delivering the clinker at the other end whereby the fuel is burned to clinker without being disturbed or broken up, and the perforations are thus not choked or the lie of the fuel disturbed.

In witness whereof I have hereunto signed my name, this 19th day of November, 1902, in the presence of two subscribing witnesses.

JOHN ARMSTRONG.

Witnesses:

J. PHILLIPS CRAWLEY,

FRANK DUCK.