No. 790,899. PATENTED MAY 30, 1905.

B. HOLBROOK.

HEAT GENERATOR AND FURNACE.

APPLICATION FILED MAR. 2, 1903.

2 SHEETS—SHEET 1.

Fig. 1.

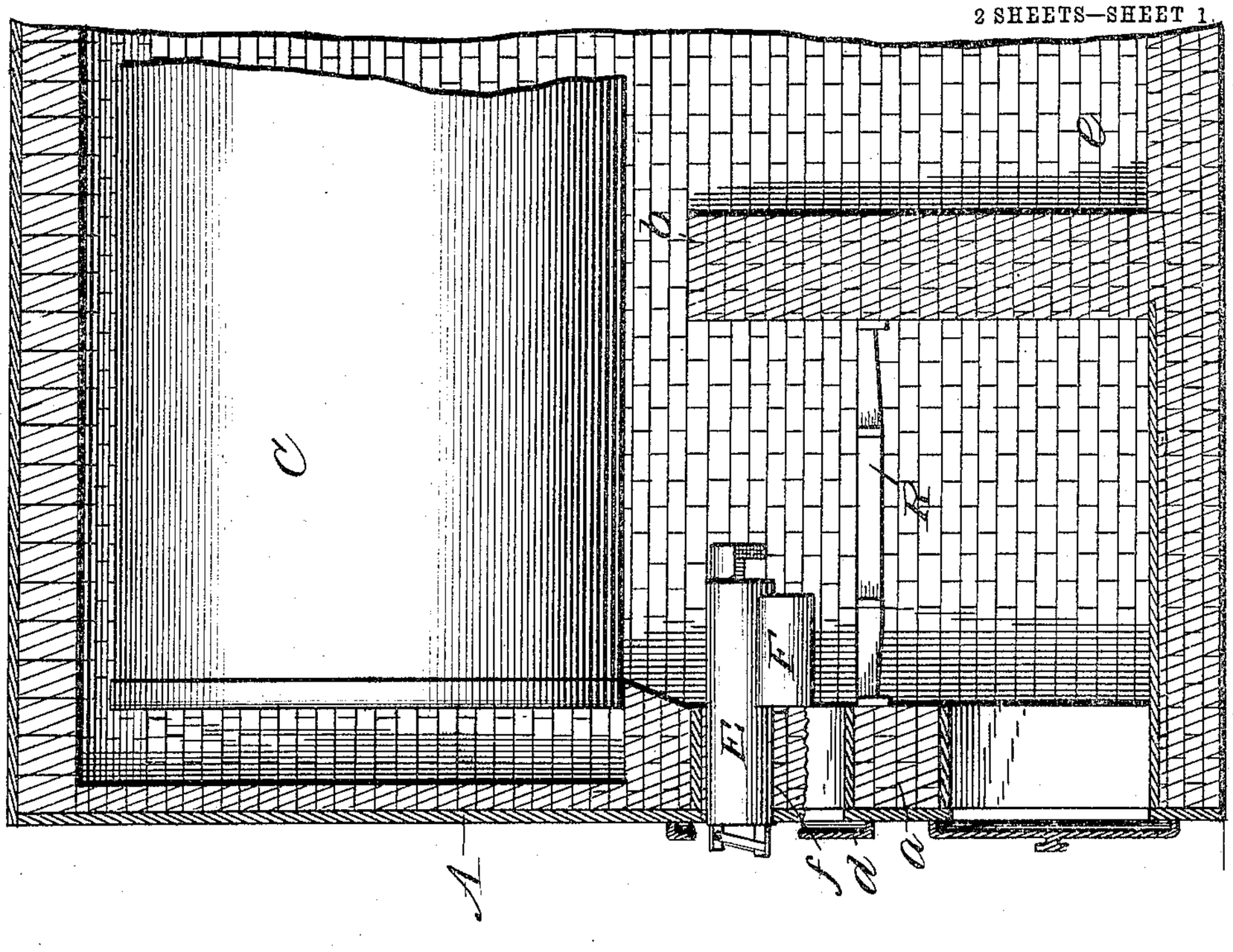
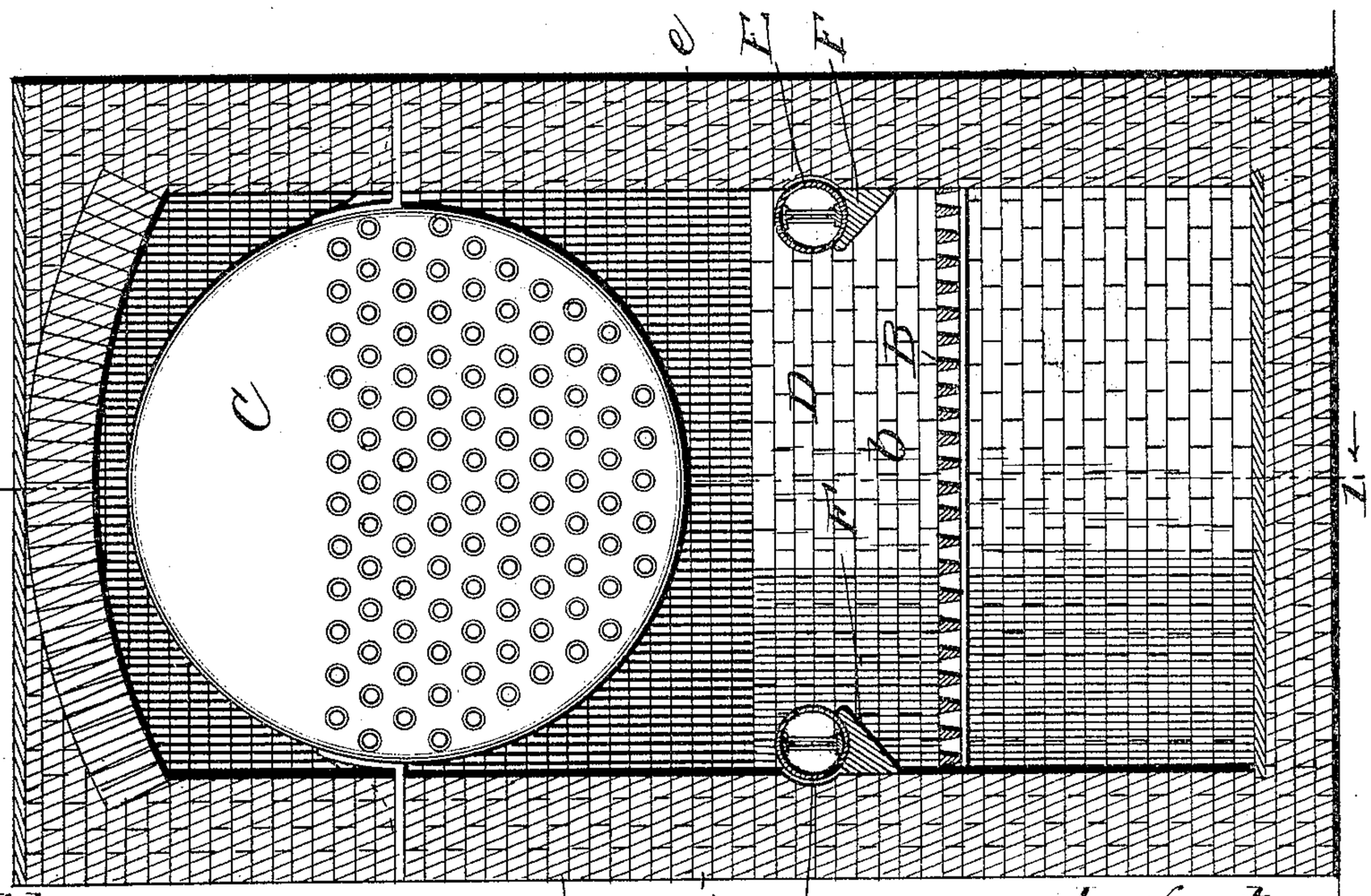


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

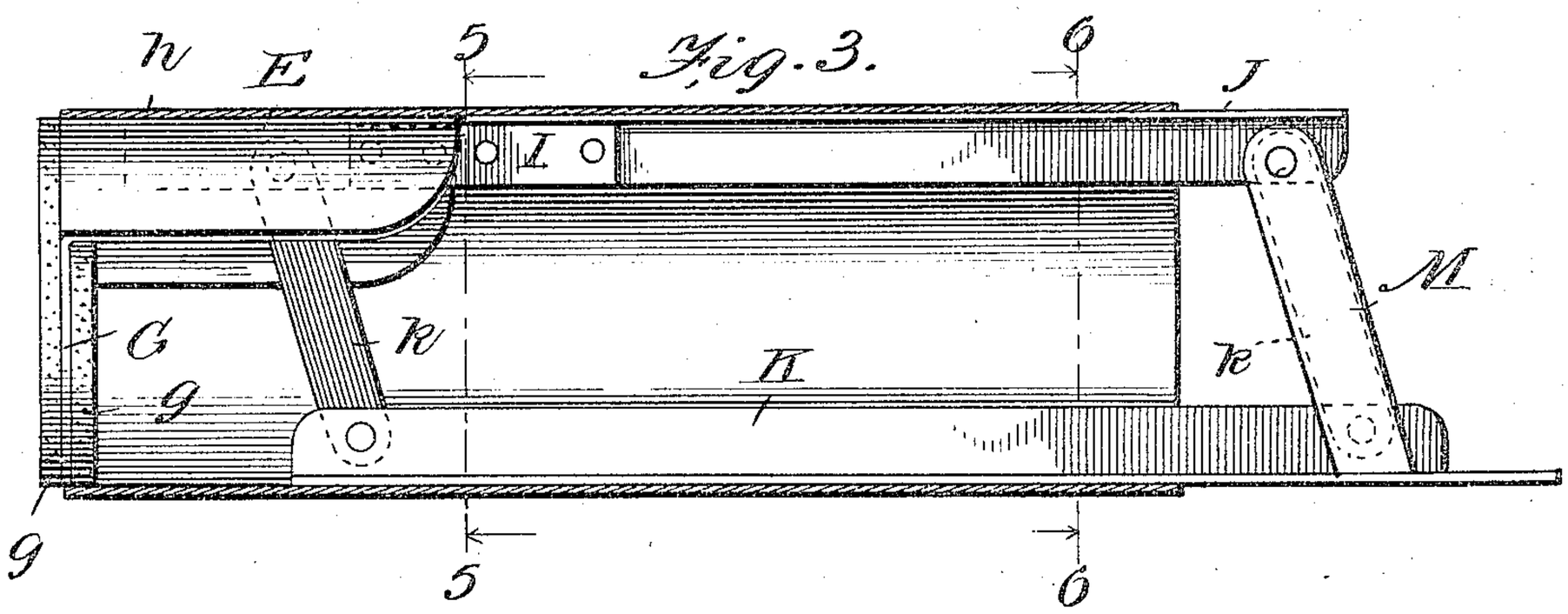


Fig. 4.

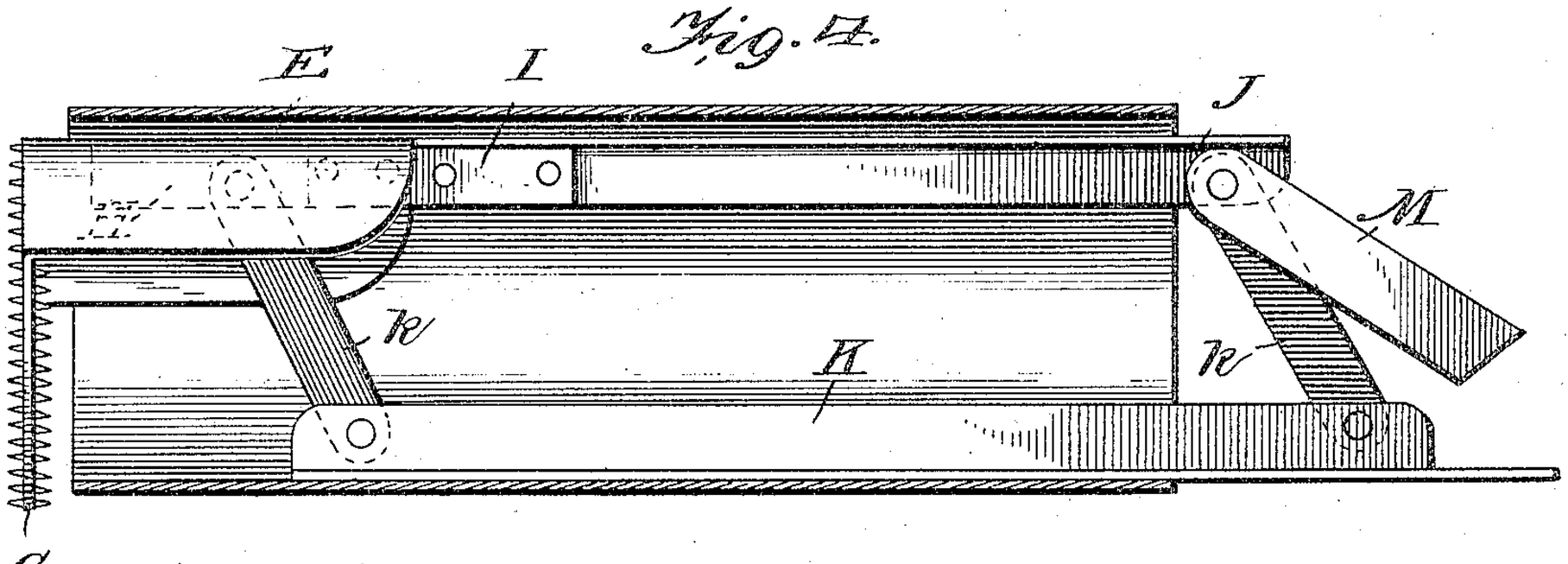


Fig. 5.

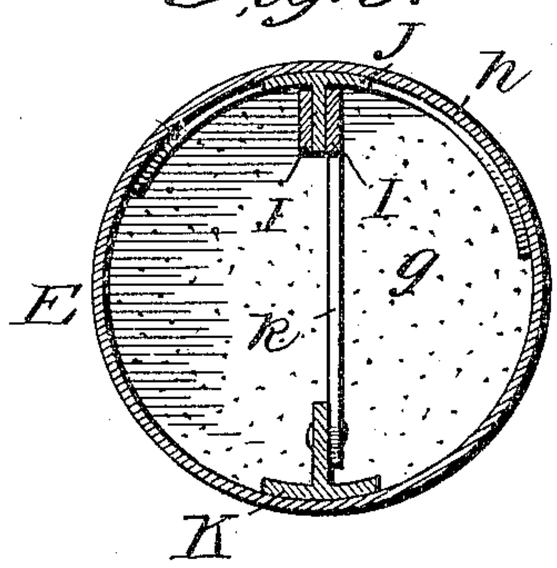


Fig. 6.

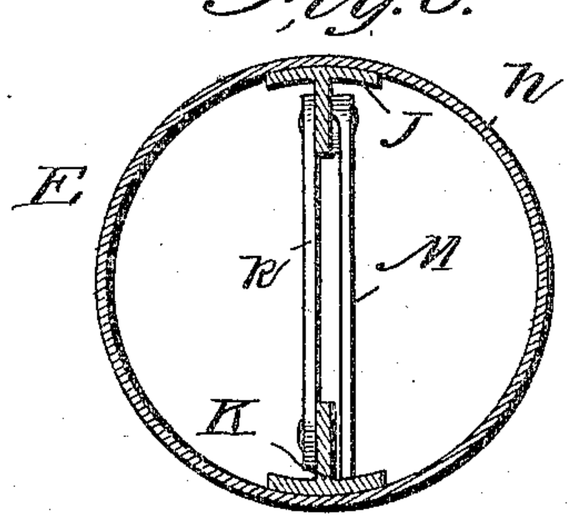
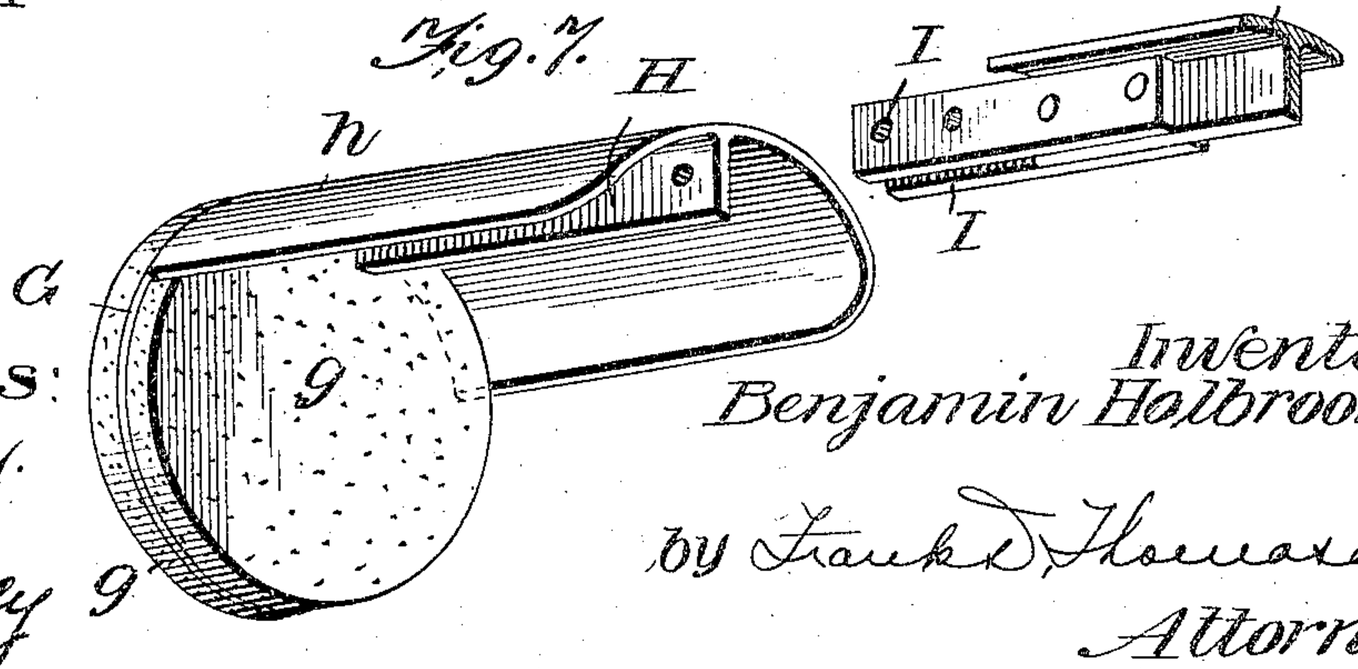


Fig. 7.



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No. 790,899. Patented May 30, 1905.

UNITED STATES PATENT OFFICE.

BENJAMIN HOLBROOK, OF CHICAGO, ILLINOIS.

HEAT-GENERATOR AND FURNACE.

SPECIFICATION forming part of Letters Patent No. 790,899, dated May 30, 1905.

Application filed March 2, 1903. Serial No. 145,742.

To all whom it may concern:

Be it known that I, BENJAMIN HOLBROOK, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Heat-Generators and Furnaces, of which the following is a full, clear, and exact description.

The idea of injecting air into the fire-pot or fire-chamber of a heat-generating apparatus in a more or less heated condition is old, and the introduction of such air above the fire-bed by artificial pressure and by natural draft is old; but the introduction of heated air into the fire-chamber under great pressure by the utilization of natural laws prevailing in said fire-chamber, supplemented by the normal atmospheric pressure in such manner that its point of introduction or commingling with the hottest gases of combustion in the heat strata or zone and chemical vortex just above the fire-bed, where the heat is intense and greatest chemical action takes place, is new. This heat strata and the vortex or point where the gaseous elements of combustion have an initial tendency to concentrate and be densest differs in every furnace according to the structural differences thereof, according to the character of the fuel used, according to the differences in the quantity of fuel used and the manner in which it is supplied to the fire-chamber, according to the draft, and according to the differences in prevailing atmospheric conditions.

The object of my invention is to inject the proper quantity of outer atmosphere into the fire-chamber of a heat-generator at this important point therein by means which are to a certain extent protected from this intense heat and chemical action resulting therefrom, which can be adjusted so as to regulate within the fire-chamber the ingress of air, which are easily removed or replaced, and which cause such a thorough mixing of the air in said chamber as to positively cause the burning of the gases liberated by the burning fuel, and thus not only increase the heat units obtained therefrom, but also to practically annihilate and prevent the discharge of smoke from said fire-chamber as well.

In the drawings, Figure 1 is a vertical longitudinal section of the forward portion of a steam-boiler furnace, taken on dotted line 1 1, Fig. 2, looking in the direction indicated by the arrows and having a portion of the front wall cut away to expose the full length of the air-injecting tube to view. Fig. 2 is a vertical transverse section taken in a vertical plane just back of the front wall of the furnace. Fig. 3 is a longitudinal central section of my improved air-injecting tube, showing it closed. Fig. 4 is a similar view showing it open. Fig. 5 is a transverse section of the same, taken on dotted line 5 5, Fig. 3, looking in the direction indicated by the arrows. Fig. 6 is a transverse section of the same, taken on dotted line 6 6, Fig. 3, looking in the direction indicated by the arrows. Fig. 7 is a perspective view of the valve and a portion of its stem, the latter disconnected therefrom.

Referring to the drawings, A represents a boiler-furnace of the usual construction. comprising a front wall *a*, a bridge-wall *b*, the grate-bars B, and the boiler C, with its forward end resting on a ledge made by reducing the thickness of the front wall. This front wall has the usual ash-pit door therein and the usual door *d* leading to the fire-chamber D, and on each side of door *d* in a vertical plane next the inner surfaces of the side walls *e e* of the furnace said front wall is provided with longitudinal openings *f f*, through which the tubular air-injecting tubes E E are adjustably inserted. These air-injecting tubes are, preferably, of the same transverse dimensions throughout their length, and preferably, cylindrical, as shown, and their length is such that when inserted through openings *f* so that their outer ends are about flush with the outer mouth of said openings about one-half their length will be within the fire-chamber D. The extent of the introduction of said air-injecting tubes into the fire-chamber is governed by the location of the vortex of chemical action and heat, and this it is necessary to ascertain in each instance before the best results can as a rule be obtained. In order to support this exposed part of the air-injecting tube and at the same time protect it from the intense heat, I have provided brackets F F therefor, which

are preferably built by cornicing out the brick from the side walls of chamber D, but which may be made of some non-combustible refractory material, such as retort-cement, for instance. The air-injecting tubes are, preferably, also adapted to be easily removed and replaced in openings *f* end for end or to permit new ones to be substituted therefor, because the heat is so intense that they will burn up sooner or later, although much more durable than anything used for a similar purpose heretofore in so far as known to me.

In view of the different density of the outer atmosphere at different times the difference in the character of the fuel, the manner in which it is supplied to the fire-chamber, &c., it is very unsatisfactory attempting to control the supply of air discharged from the inner end of the air-injecting tube into the fire-chamber by means located at the outer end of the same. I have therefore provided the inner end of said air-injecting tube with a closure comprising a valve G, consisting of a circular plate of a diameter a little less than the inner diameter of the air-injecting tube into the inner end of which it is designed to enter to close the same.

If desired, in order to render it less susceptible to heat it may be provided with a thick coating of retort-cement or other material *g g* on each side. In this event the valve would be cast with protuberances on each side in order to provide a purchase or hold for the cement.

The upper segment of valve G is provided with a hood *h*, which projects horizontally outward from the edge of said valve and preferably conforms in curvature throughout its length to that of said edge. This hood extends down farther on the side next the side wall of the furnace than on the opposite and is provided with a downwardly-projecting longitudinal rib H, which preferably is coextensive in length therewith. This rib is connected, by means of fish-plates I I, to the contiguous end of an inverted-T-iron plunger J, which latter extends out through the air-injecting tube, next the upper side thereof, to a point which when the valve is closed is slightly beyond the outer end of the same. The outer end of the plunger J and rib H (at about its center of length) are connected to a parallel T-iron rod K by links *k k* after the manner of parallel rulers. The normal position of rod K is in the air-injecting tube opposite plunger J, and the outer end of this rod K extends beyond the outer end of the air-injecting tube. After the valve G is adjusted to the position desired by means of plunger J it is locked in this position by pushing rod K inward, which separates the plunger and rod and causes them to bear outward against the sides of the air-injecting tube. In this latter position said plunger and rod are held by means of an arm M, which is preferably pivoted to the outer end of the vertical portion of the plunger and is of such length that when swung downward as far as it will go bears against the horizontal flanged portion of rod K and retains the plunger and rod in their separated positions.

I do not desire to be confined to any particular means for supporting the valve G in any position to which it may be adjusted nor to any particular device for locking it in its adjusted position. It is desirable, however, while not absolutely necessary, that whatever means are employed for this purpose the valve can be removed therefrom and replaced with a new one when necessary.

In operation after the air-injecting tubes are shoved into place they are adjusted longitudinally, so as to discharge just at the right point. In this position they soon become very highly heated in spite of the protection afforded them by the brackets, and the air passing therethrough when the valve is opened reaches a very high temperature by the time it enters the fire-chamber. The constituent gases of the atmosphere, however, remain as they originally were, although greatly expanded, until they are discharged from the inner mouth of the air-injecting tube, whereupon they instantly commence to combine with the gases of combustion generated by the burning fuel on the grates and burn. The draft of the furnace, the burning and consequent destruction of the atmospheric gases upon reaching the fire-chamber, and the atmospheric pressure all combine to cause an almost hurricane rush of gaseous pressure from the inner end of the air-injecting tube, which, burning, impinges against and is spread by the valve and then deflected by the hood downward and inward into the fire-chamber. Now if it is attempted to control the intake of outer air into the air-injecting tube by devices secured or connected to the outer end thereof the conditions hereinbefore stated existing at the discharge end of said air-injecting tube simply make up for the diminished volume of outer atmosphere taken into the same by increasing the spread of the same. This is not the case when the closure of the air-injecting tube is a valve or equivalent device secured or connected to its inner end, as such a valve regulates the conditions—that is, the extent of the condition taking place at the inner end of the air-injecting tube—besides reducing the volume of intake of the heated outer atmosphere, and thus absolutely control the requirements of the furnace in so far as the factors combustion and annihilation of smoke are concerned, according as the several conditions hereinbefore referred to may vary.

From the foregoing it will be apparent that the adjustability of the air-injecting tube permits the discharging of the air into the fire-chamber of the furnace at just the right point

to accomplish the best results and that the regulation of the valve closing the inner end of said air-injecting tube controls the quantity of heated air to be discharged from the air-injecting tube into said fire-chamber. These two all-essential features, together with the removability of the air-injecting tube, constitute the gist of my invention, and it makes no difference what the changes are that may be made in the construction and disposition of said elements. So long as they accomplish these results or any of them I desire to be understood as considering the same as coming within the scope of my invention.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a heat-generator having an opening in its vertical walls extending from the outside into the fire-chamber thereof, and provided with a bracket or ledge integral with the walls of the fire-chamber in alinement with the bottom of said opening, of an air-injector consisting of a removable air-injecting tube adapted to be inserted in said opening and have its inner end shielded by said bracket or ledge.

2. In a heat-generator, an air-injector consisting of an air-injecting tube, a valve for closing the inner end of the same, having a hood extending horizontally inward therefrom, and a plunger extending through said air-injecting tube to the inner end of which said valve is secured.

3. In a heat-generator, an air-injector consisting of an air-injecting tube, a valve for closing the inner end of the same, having a hood extending horizontally inward therefrom, and a plunger extending through said air-injecting tube to the inner end of which said valve is removably secured.

4. In a heat-generator, an air-injector consisting of an air-injecting tube, a disk-shaped valve for closing the inner end of the same having a hood projecting horizontally from its upper segment and having a longitudinal rib extending from the under side of said hood, a plunger extending longitudinally through said air-injecting tube, and fish-plates removably connecting the rib of said hood and the inner end of the plunger.

5. In a heat-generator, an air-injector consisting of an air-injecting tube, a disk-shaped valve, an adjustable plunger extending longitudinally through said air-injecting tube to the inner end of which said valve is removably secured, and means for locking said plunger in its adjusted positions.

6. In a heat-generator comprising a fire-chamber having an opening in its vertical wall extending from the outside thereof into said fire-chamber, and provided with brackets or ledges projecting from the inner surface of said wall in continuation of said opening, an air-injecting tube removably insertible in said opening the inner end of which is above said bracket or ledge, a removable adjustable valve at the inner end of said air-injecting tube, and means for locking said valve in its adjusted position.

In testimony whereof I have hereunto set my hand this 11th day of February, 1903.

BENJAMIN HOLBROOK.

Witnesses:
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LOUIS F. MUELLER.