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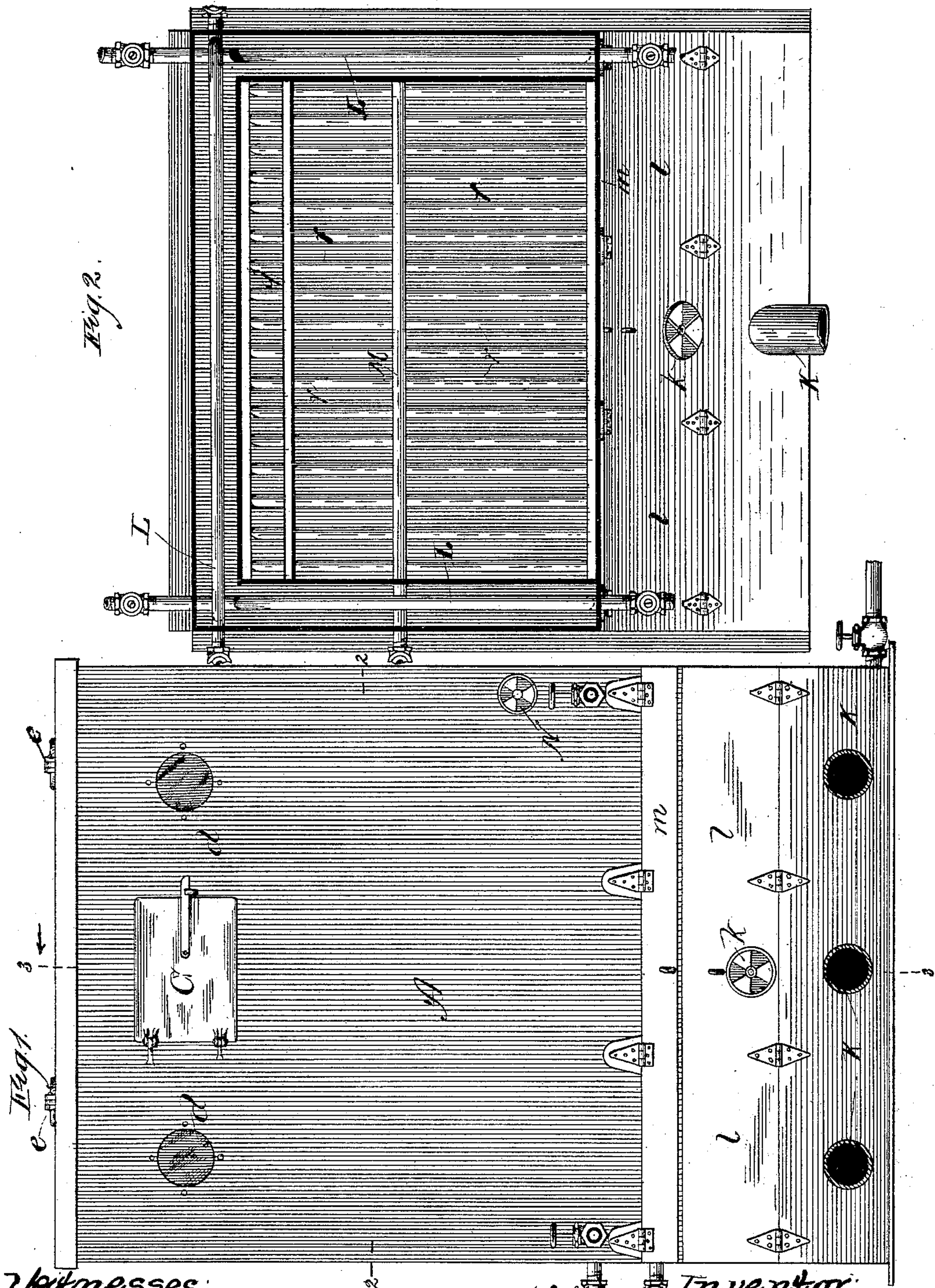
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J. M. AYER.

APPARATUS FOR PRODUCING GASEOUS FUEL.

No. 432,718.

Patented July 22, 1890.



Witnesses:  
Efford & White.  
J. H. Dyrenforth.

Inventor:  
John M. Ayer,  
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Attys.



(No Model.)

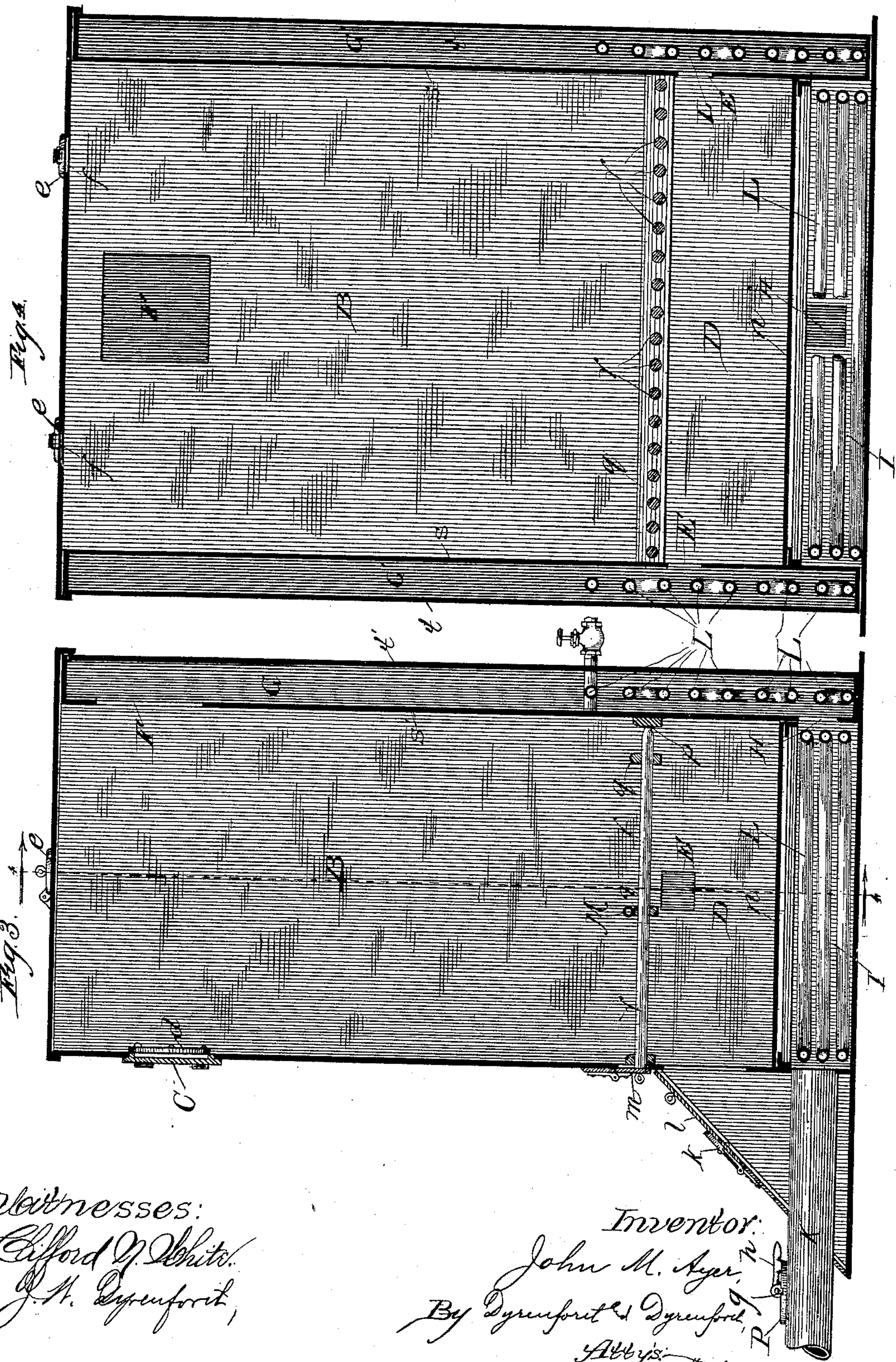
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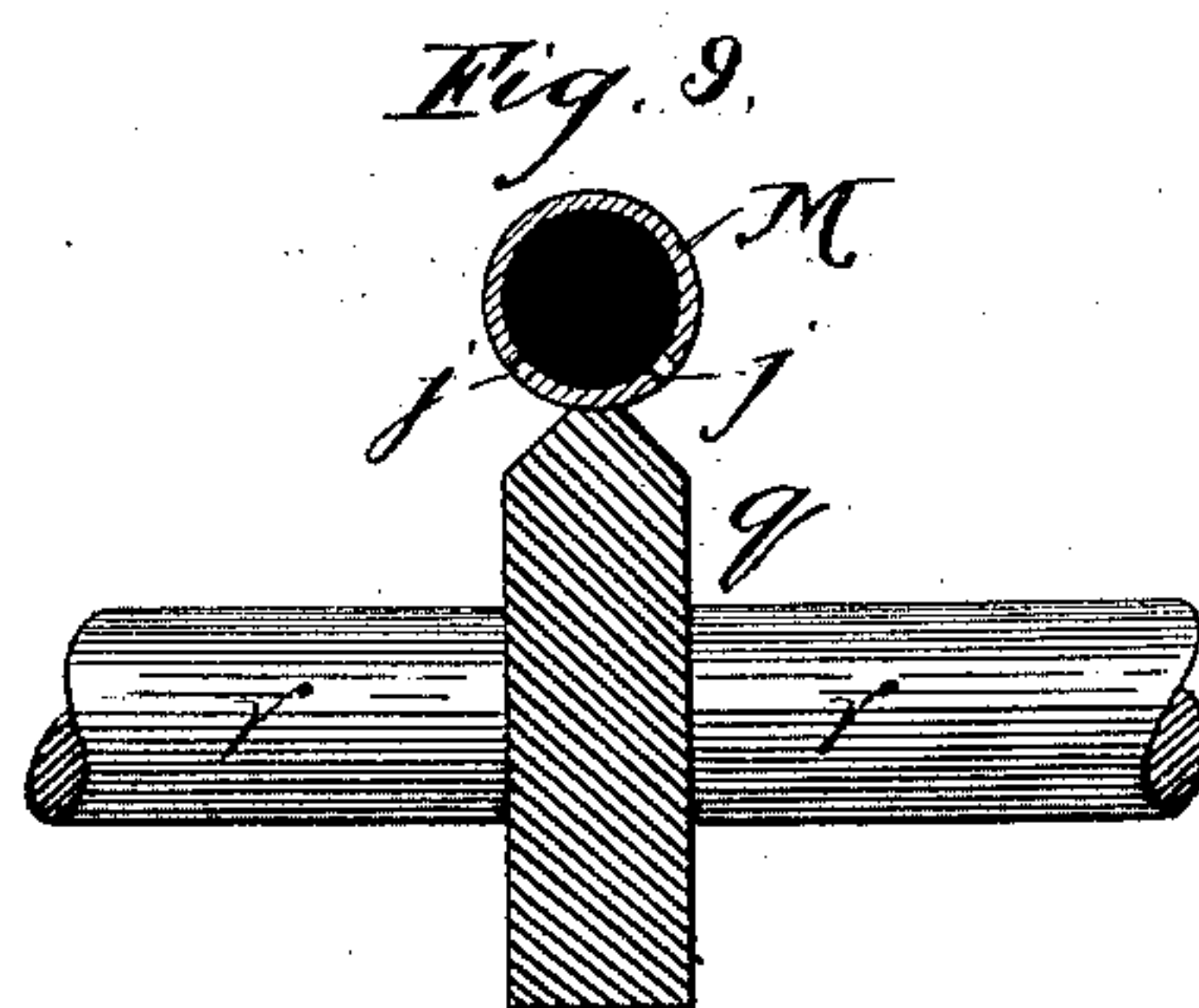
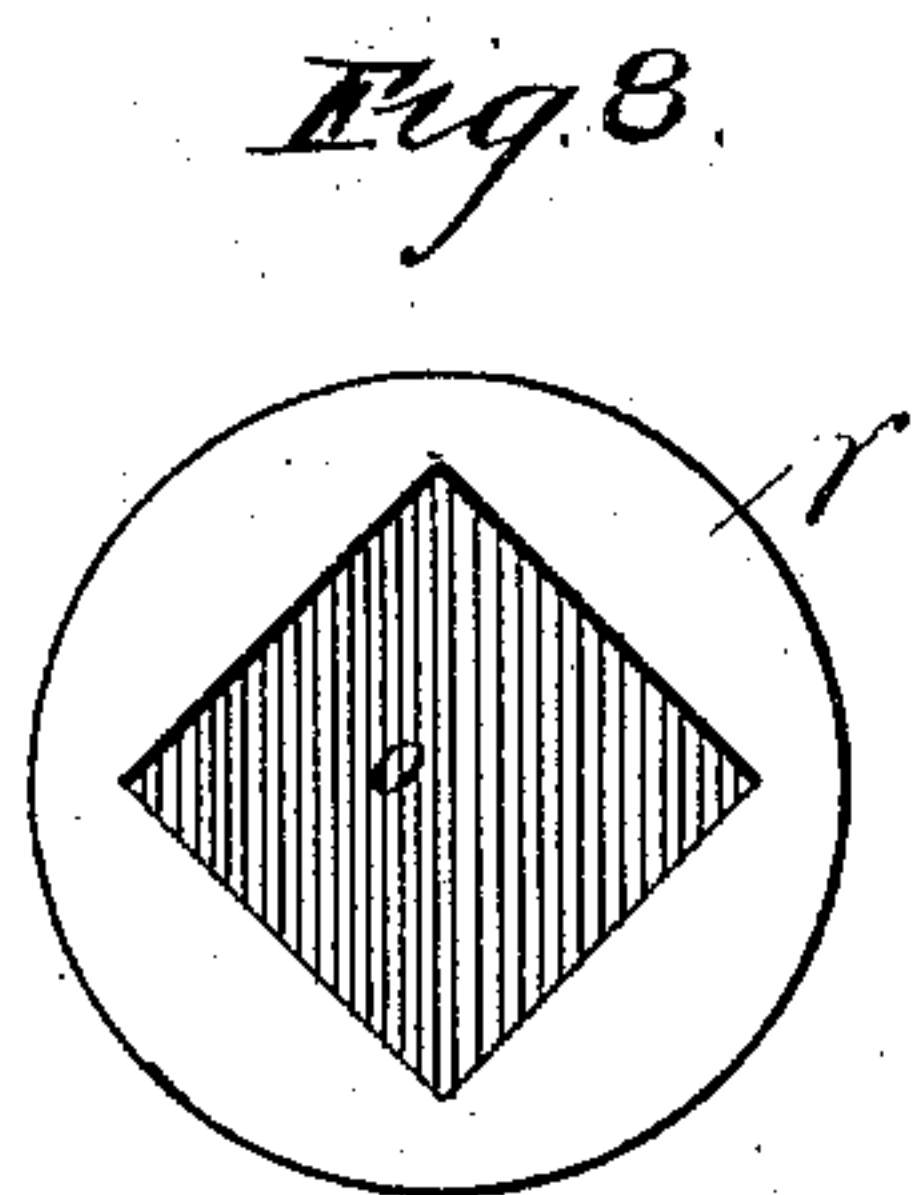
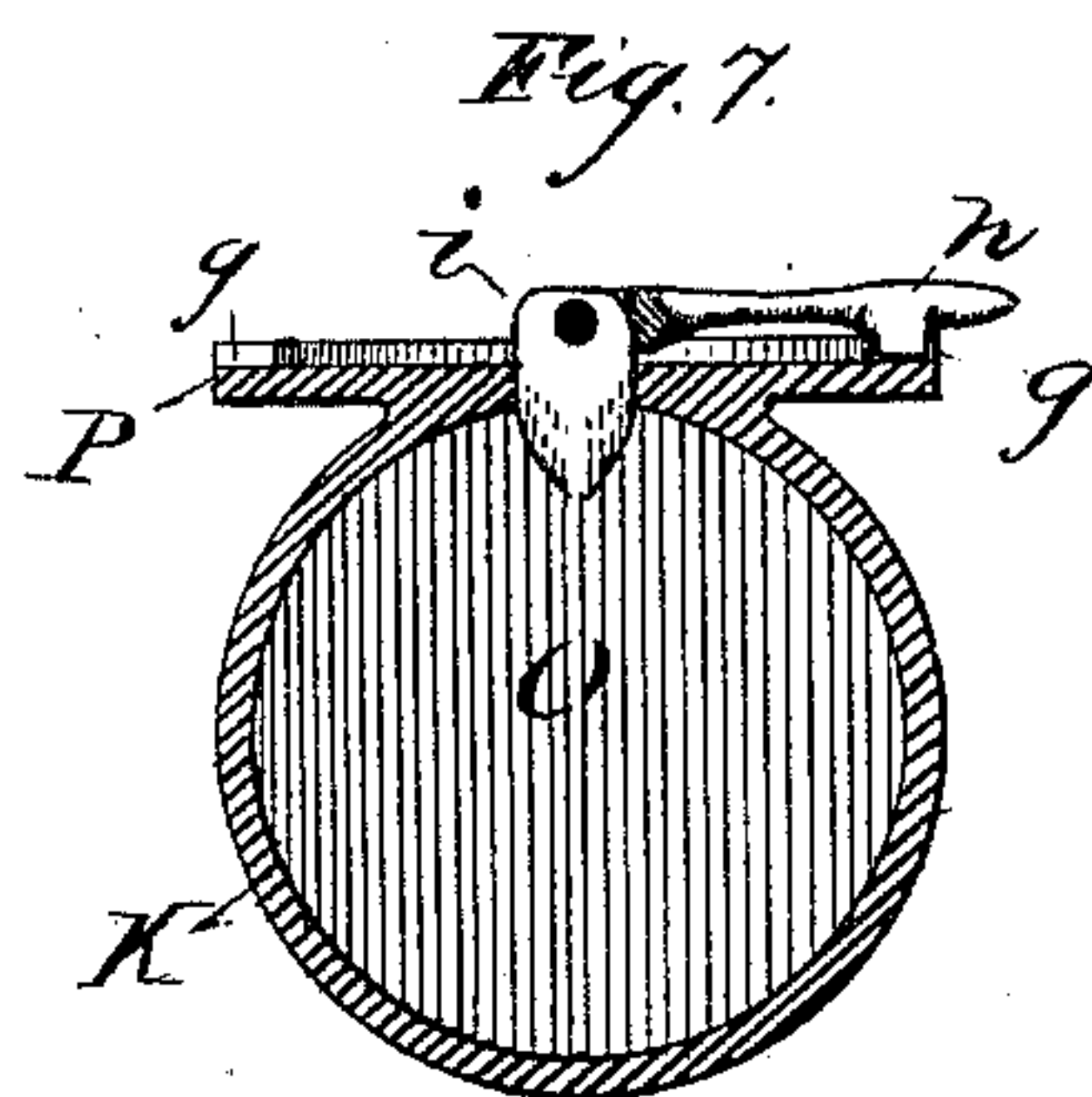
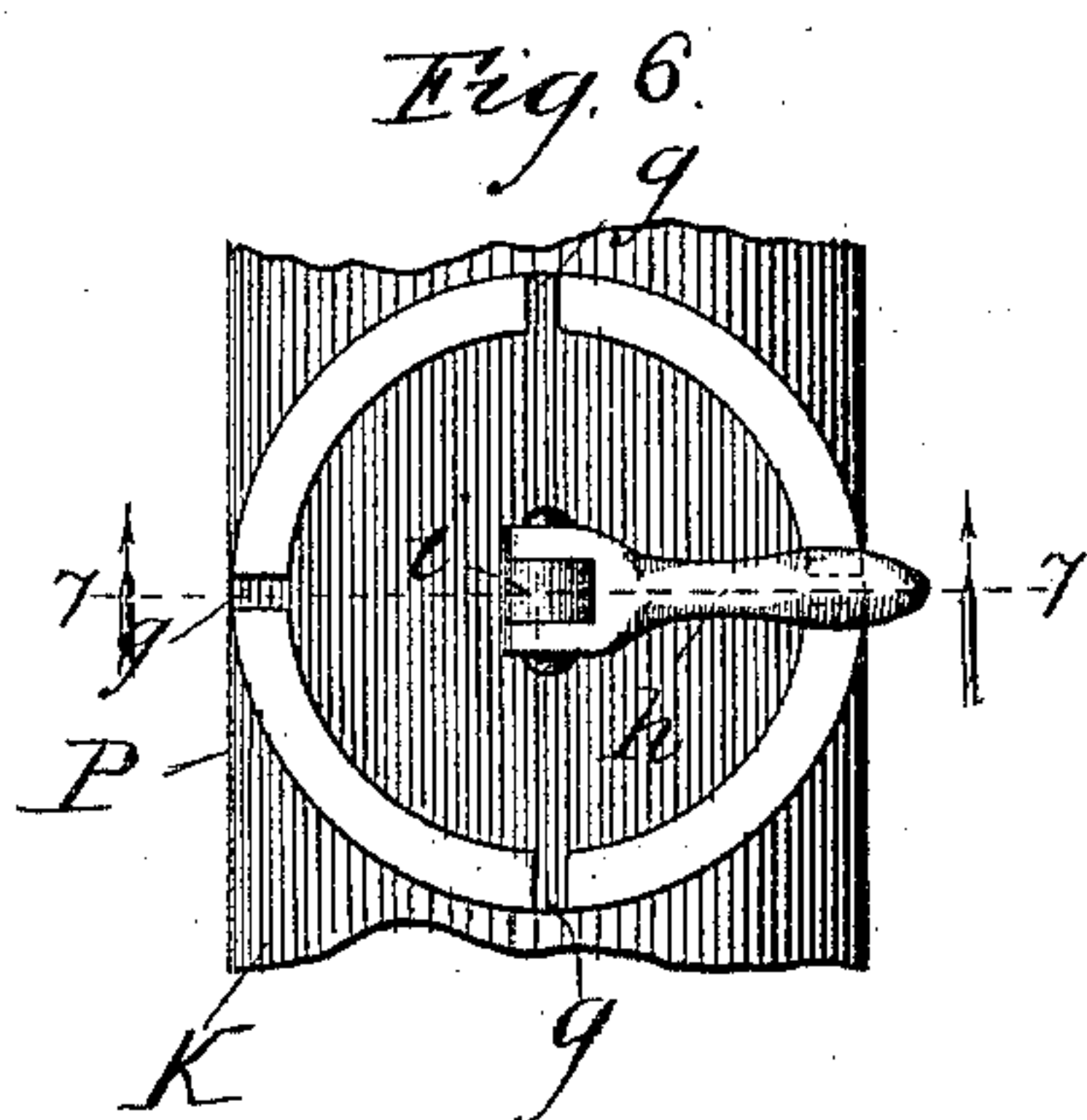
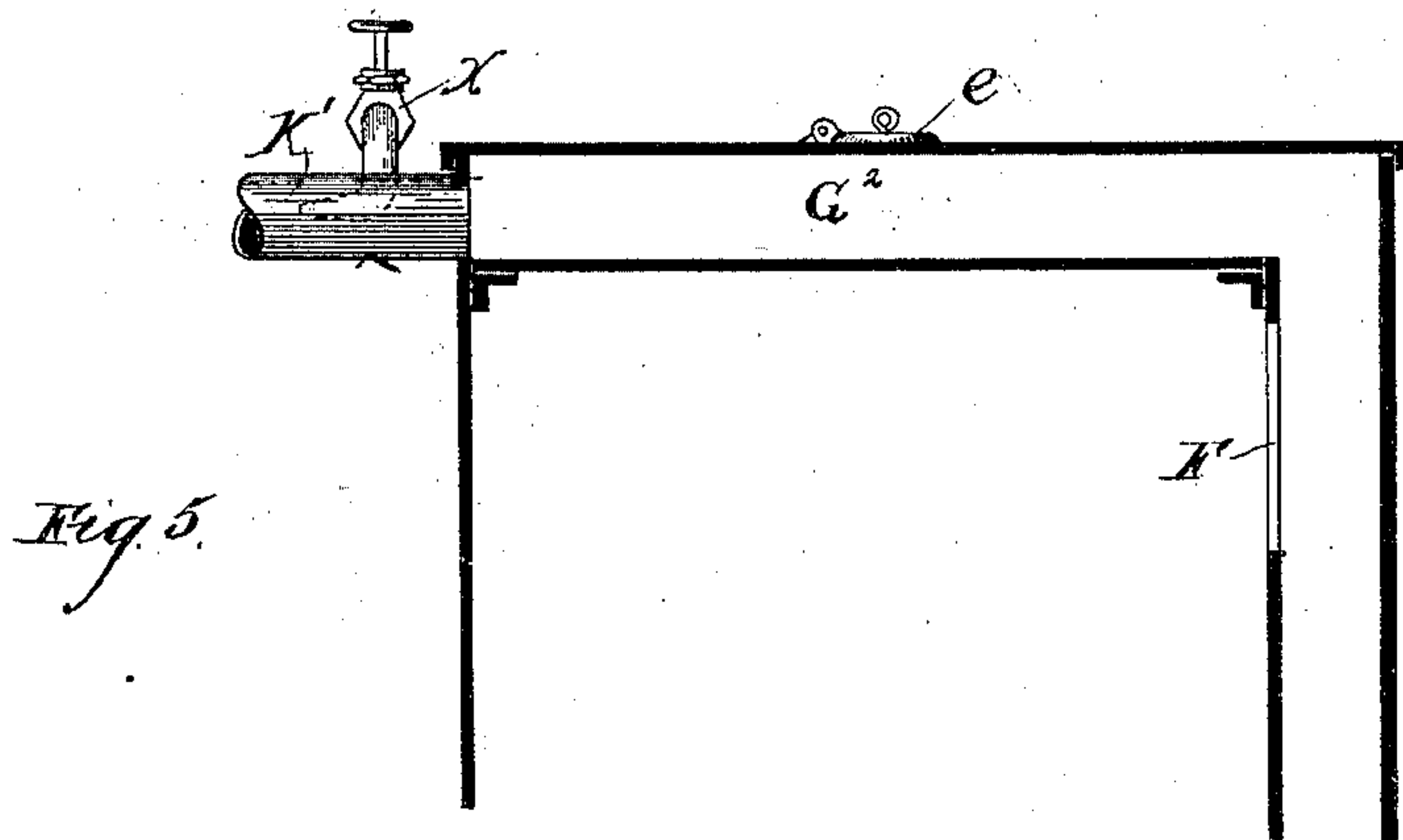
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# UNITED STATES PATENT OFFICE.

JOHN M. AYER, OF CHICAGO, ILLINOIS.

## APPARATUS FOR PRODUCING GASEOUS FUEL.

SPECIFICATION forming part of Letters Patent No. 432,718, dated July 22, 1890.

Application filed November 7, 1889. Serial No. 329,483. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN M. AYER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have  
5 invented a new and useful Improvement in Apparatus for Producing Approximately Complete Combustion of Fuel, of which the following is a specification.

The object of my invention is to obtain from  
10 either anthracite or bituminous coal, in whatever form, substantially all the units of heat which the fuel is capable of affording by first distilling from the fuel the gases within an inclosed chamber, with or without the use of  
15 steam, as circumstances may require, then causing heated atmospheric air to become commingled with these gases, also within an inclosed chamber, heating these commingled aeriform bodies to a high temperature while  
20 thus inclosed, and while still in their highly-heated state liberating them at the place of ignition, so that when ignited substantially complete combustion shall result. The place of ignition may be any fire-chamber where  
25 the direct action of heat is required, and hence my invention is applicable to metallurgic furnaces and all others.

My invention consists in the process above outlined; also in the general form of apparatus  
30 which I employ for carrying the above operations into effect, and also in various details of construction and combinations of parts which contribute to the efficiency of the apparatus.

35 In the accompanying drawings, Figure 1 is a front elevation of my improved producer; Fig. 2, a horizontal section of the same, taken on the line 2 2 of Fig. 1 and viewed downward; Fig. 3, a vertical section taken on the line 3 3  
40 of Fig. 1 and viewed in the direction of the arrows; Fig. 4, a vertical section taken on the line 4 4 of Fig. 3 and viewed in the direction of the arrows; Fig. 5, a broken sectional view corresponding with the upper portion of that  
45 represented in Fig. 3, but showing a modification. Fig. 6 is a plan view of the damper-regulating device in the discharge-flue which conveys the commingled and heated aeriform bodies to the place of ignition; Fig. 7, a ver-  
50 tical section of the same, taken on the line 7 7 of Fig. 6; Fig. 8, a front end view of one of the grate-bars; and Fig. 9, an enlarged sec-

tional view of a detail, showing the construction of the steam-pipe, by means of which live steam may be caused at will to commingle  
55 with the products of combustion.

A is the producer, the walls and top of which may be formed of iron, brick, or other suitable material, according to the size or the application to which it is to be put or the vari-  
60 ous other circumstances and conditions which may exist.

The side and rear walls of the producer A are made double, as shown in the drawings, wherein *t t* represent the outer side walls, *t'*  
65 the outer rear wall, *s s* the inner side walls, and *s'* the inner rear wall. At a proper height above the base of the inclosure formed by the inner walls is a series of round grate-bars  
70 *r*, supported in cross-bars *q*, extending from side to side of the interior. The grate-bars pass through holes in the cross-bars *q*, and are revoluble therein. The inner ends of the grate-bars, in order to overcome friction, are  
75 made tapering and rest against the rear wall of the producer or a plate thereon, as shown at *p*, and the forward ends, which are accessible from the outside of the furnace, are provided with angular sockets *o* to receive the  
80 end of a crank, the design being to oscillate the grate-bars singly. At a distance below the grate-bars sufficient to afford an ample ash-pit is a horizontal partition *n*, formed preferably of metal, and below this partition is the  
85 lowermost interior chamber, the function of which will be explained farther on.

At the front of the producer a hinged door  
90 *m* is provided, reaching substantially the whole width of the producer, and below the level of the grate-bars and in front of the ash-pit is an inclined hinged door *l*, opening downward and provided with one or more controllable draft-openings *k*. The interior chamber B above the grate-bars is the primary combustion-chamber, into which the  
95 fuel is fed in any ordinary way, as through the man-hole C. The chamber D below the grate-bars, besides being the ash-pit and, as usual, the avenue for the passage of atmospheric air through the grate-bars to the fuel  
100 to support combustion, performs an additional and highly-important function in my producer by reason of the openings E in the side walls, which admit air from chamber D



into the side chambers formed by the double walls *s* and *t*. The drawings show one opening *E* at each side of the chamber *D*; but this number may be increased, if desired.

5 The products of combustion generated within the primary combustion-chamber *B* find an outlet through the opening *F* in the rear inner wall *s'* into the rear outer chamber *G*, where they encounter atmospheric air which

10 has passed by way of the chamber *D*, through the openings *E*, into the side chambers *G'*. While the side chambers *G'* and rear chamber *G* form in effect one continuous chamber, partly inclosing the primary combustion-

15 chamber, it is convenient for purposes of description, owing to the different functions of the different parts to refer to these different parts as separate chambers, as I have done above. The line of draft from the primary

20 combustion-chamber to the place of ignition is through the opening *F*, thence down the rear chamber *G*, through the opening *H*, into the lowermost chamber *I*, and thence out by way of the delivery-flue *K*, of which there

25 may be one, as shown in Fig. 2, or more, as shown in Fig. 1. It will be obvious, also, that more than one opening *H* and more than one opening *F* may be employed if the conditions so require.

30 As stated before, one of my principal objects is to raise the commingled aeriform bodies to a temperature which will insure substantially complete combustion when ignition takes place. For this purpose I provide within

35 the inclosing-chambers and lowermost chamber steam-coils *L*, which may receive steam from any convenient source—as, for example, from a boiler heated by the ignited products of the generator itself. These steam-coils are

40 separate from each other in the several chambers and are provided with exterior regulating-valves in the usual way, as shown, so that steam may be admitted to them or cut off from them separately at will. Those in the side

45 chambers and rear chamber may extend to the height represented or to any other height therein which the conditions may render desirable.

For use, when deemed desirable, a steam-

50 pipe *M*, having perforations *j* below its median horizontal plane, is supported upon one of the cross-bars *q* near the center of the grate. This steam-pipe may derive its supply from the same source as the several

55 steam-coils, and like them, it is provided with an exterior regulating-valve.

The operation of my producer is as follows: Combustion having been started in the primary combustion - chamber, it proceeds

60 throughout the entire operation at a comparatively slow rate without material acceleration, and hence without waste. The products of combustion which accumulate above the fuel in the primary combustion-chamber consist

65 largely of carbonic oxide, carbureted hydrogen, and hydrogen associated with steam, in case the steam-pipe *M* is in operation. These

pass into the rear chamber *G*, which I denominate the “mixing and heating chamber,” since in this chamber the gaseous products 70 from the primary combustion-chamber become commingled with atmospheric air, and thus commingled are additionally heated, not only by the rear steam-coil, over which they must pass on their way to the opening *H*, but also 75 by radiation from the highly-heated wall *s'*, which incloses the burning fuel. The air which thus commingles with the gaseous products of combustion is derived wholly or in part by way of the passages *E* from the chamber *D*. The 80 door *l* being open, air from the outside rushes by natural draft into the chamber *D* and there divides, part of it passing up through the grate-bars and part of it passing through the openings *E* into the side chambers *G'*, 85 which I denominate the “air-heating portion” of the mixing-chamber, since the air, while on its way in the line of natural draft to the rear chamber, becomes highly heated by contact with the steam-coils in the chambers *G'*, and 90 also by the radiation from the walls *s*, which inclose the burning fuel. If desired, valved openings *N* may be provided leading from the exterior air directly into the chambers *G'*. The 95 lowermost chamber *I*, through which the commingled aeriform bodies finally pass before entering the flue *K*, I denominate the “reheating-chamber.” The steam-coil *L* within it is aided by the effect of the hot ashes and cinders, which find a lodging-place upon the hori- 100 zontal partition *n*, constituting the base of the ash-pit and the top of the reheating-chamber, and thus the temperature of this chamber becomes very high. It will thus be seen that the general construction and arrangement of 105 my producer are such as to economize and utilize all the heat of every portion and concentrate it upon the one object of raising the highly-inflammable ultimate product to a temperature at which substantially complete 110 combustion will follow as the result of ignition. The natural draft through the discharge-conduit *K*, induced by the combustion of the gaseous compound at the place of ignition, and the consequent approximate vac- 115 uum thus created, will serve alone under ordinary conditions to create the requisite currents through the various channels and cause their convergence into the line of direct draft with the resultant intimate association. The 120 draft may, however, be aided in any of the well-known ways—as, for instance, by the introduction into the delivery-flue of a suction-blower or steam-jet or hot-air jet, as indicated at *x*, Fig. 5. 125

To regulate the outflow through the flue *K*, I provide a damper *O* in that pipe and mechanism for adjusting it to different angles and holding it in its adjusted position, comprising the following parts: A stem *i*, rigid upon 130 the damper and extending through the top of the pipe, a handle *h*, pivotally mounted in the stem *i*, so that it may be raised and lowered upon its pivot, and a horizontal ring



P, encircling the stem *i* and rigidly secured upon the top of the conduit K and provided with notches *g*, into any one of which the handle may be dropped when brought into coincidence with it. To adjust the damper, the handle *h* is raised out of the notch in which it rests, turned to the required notch, and dropped into the latter, where of course it will remain until purposely displaced. Four notches *g* are shown in the drawings, which permit the damper to be fixed either in a wholly open or wholly closed position; but of course the number of notches may be increased if desired, and obviously they may be confined to a quadrant or semicircle without affecting the result, in which case a quadrant or a semicircle, as the case may be, may be substituted for the complete annulus. When the operation of the producer is suspended, the products of combustion should be allowed to escape to the open air by way of the openings *f* in the top, which are provided with lids *e*, so that they may be opened and closed at will. When the producer is not in the open air, these openings *f* may be provided with flues leading to the open air, in which case the lids *e* will take the form of dampers. The openings *d* in the upper part of the generator at the front are for purposes of inspection, and are provided with a transparent medium in the usual way.

The modification illustrated in Fig. 5 shows the mixing and heating chamber extended over the top of the generator, thus affording the space *G*<sup>2</sup> and the discharge flue or flues *K*<sup>1</sup> for delivering the commingled aeriform bodies at the place of ignition, extending out from this upper chamber *G*<sup>2</sup>, instead of from the lowermost-chamber, as in the form previously described. The action in the modified construction is in general the same as in the other, except that the direction of the draft is reversed, carrying off the commingled aeriform bodies to the place of ignition from the top instead of from the bottom of the generator.

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

1. A generator for abstracting inflammable gases from fuel and delivering them commingled with atmospheric air, all in a highly-heated state, to the place of ignition, comprising in combination, a primary combustion-chamber, an additional chamber partly inclosing the primary combustion-chamber and communicating with the interior thereof, and also with the external air, whereby the commingling of atmospheric air with the gaseous products of combustion is effected, an auxiliary heating means within the inclosing-chamber, and a draft-conduit leading from the inclosing-chamber to the place of ignition, substantially as described.

2. A generator for abstracting inflammable gases from fuel and delivering them commingled with atmospheric air and steam, all in a highly-heated state, to the place of igni-

tion, comprising, in combination, a primary combustion-chamber, an additional chamber partly inclosing the primary combustion-chamber and communicating with the interior thereof and also with the external air, a steam-injector for delivering steam into the interior of the primary combustion-chamber, an auxiliary heating means within the inclosing-chamber, and a draft-conduit leading from the inclosing-chamber to the place of ignition, substantially as described.

3. A generator for abstracting inflammable gases from fuel and delivering them commingled with atmospheric air, all in a highly-heated state, to the place of ignition, comprising, in combination, the primary combustion-chamber B, with its ash-pit D and draft-regulating doors, chambers G and G', partly inclosing the primary combustion-chamber and ash-pit and communicating through one or more openings F with the interior of the primary combustion-chamber and through openings E with the interior of the ash-pit, steam-coils L within the chambers G and G', and a draft-flue leading from these chambers to the place of ignition, substantially as described.

4. A generator for abstracting inflammable gases from fuel and delivering them commingled with atmospheric air and steam, all in a highly-heated condition, to the place of ignition, comprising, in combination, the primary combustion-chamber B, with its ash-pit D and draft-regulating doors, steam-injecting pipe M, extending transversely across the interior at a short distance above the grate and provided below its horizontal median plane with perforations *j*, chambers G and G', partly inclosing the primary combustion-chamber and ash-pit and communicating through one or more openings F with the primary combustion-chamber and through openings E with the interior of the ash-pit, steam-coils L within the chambers G and G', and a draft-flue leading from these chambers to the place of ignition, substantially as described.

5. A generator for abstracting inflammable gases from fuel and delivering them, commingled with atmospheric air, all in a highly-heated condition, to the place of ignition, comprising, in combination, the primary combustion-chamber B, with its ash-pit D and draft-regulating doors, chambers G and G', partly inclosing the primary combustion-chamber and ash-pit and communicating through one or more openings F with the primary combustion-chamber and through openings E with the interior of the ash-pit, a chamber I below the ash-pit communicating through one or more openings H with the rear chamber G', steam-coils L within the chambers G, G', and I, and a draft-flue K, leading from the chamber I to the place of ignition, substantially as described.

JOHN M. AYER.

In presence of—

J. W. DYRENFORTH,  
M. J. FROST.