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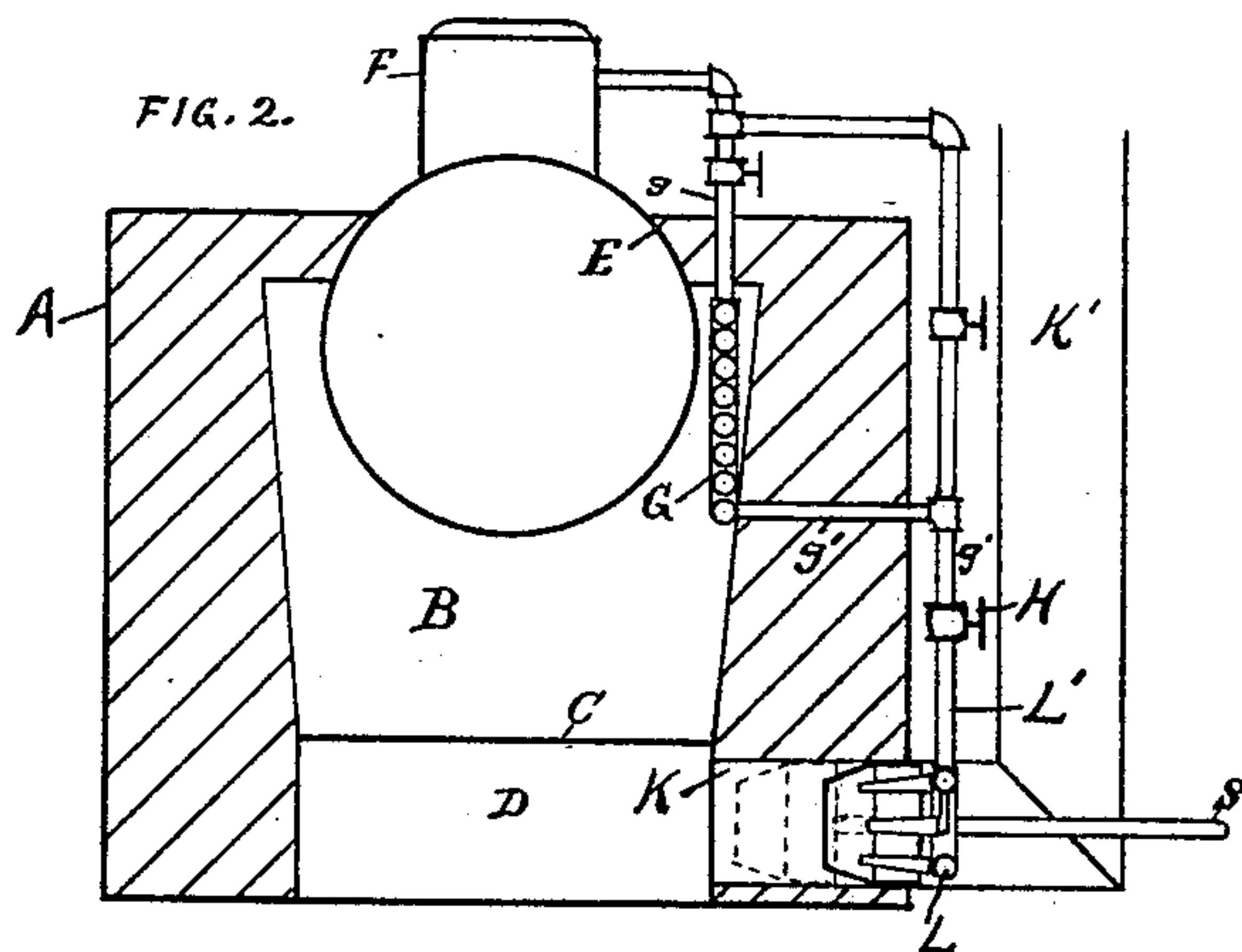
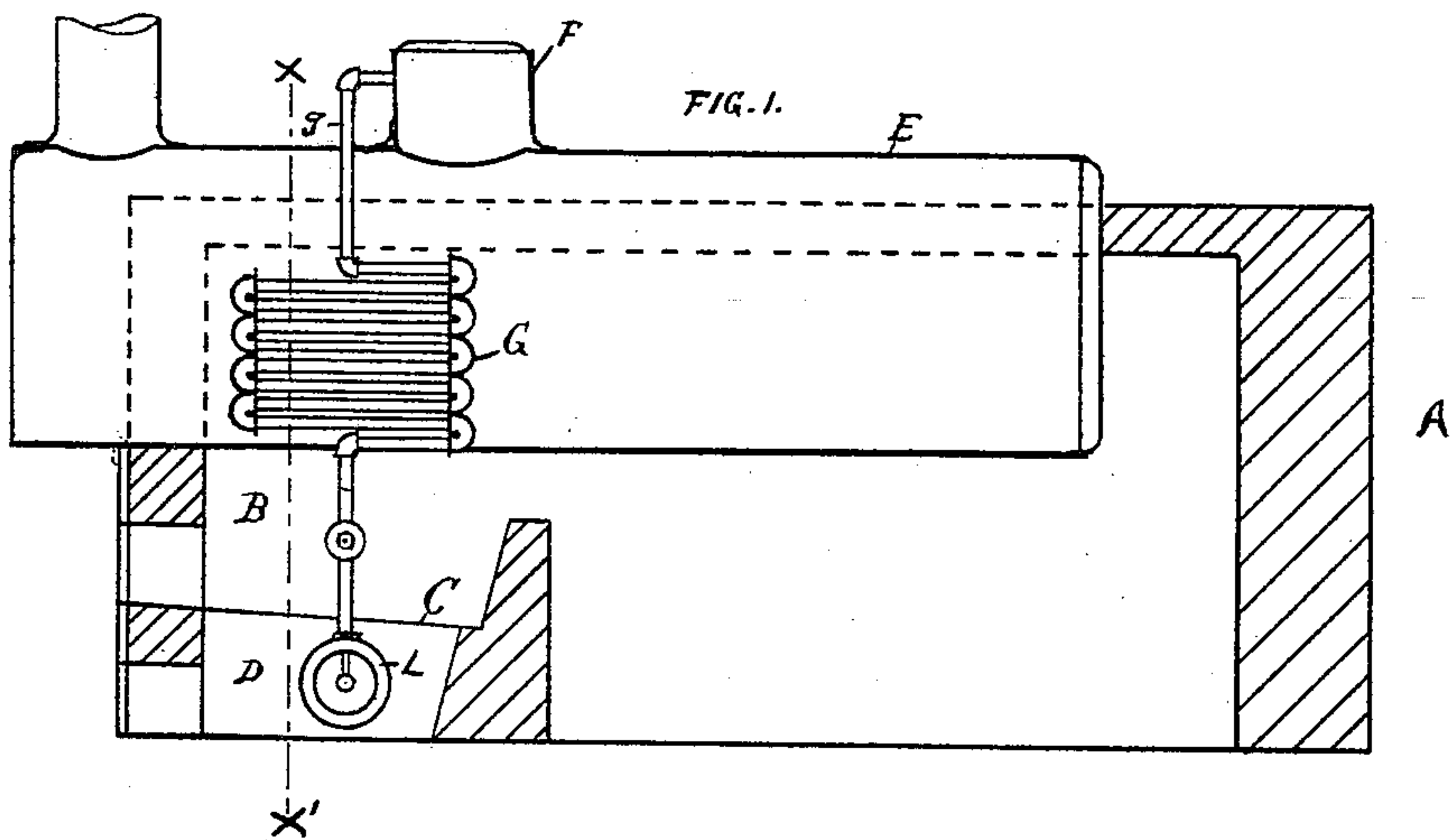
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T. H. CHAMPION.

MEANS FOR GENERATING HEAT.

No. 362,935.

Patented May 17, 1887.



WITNESSES

Geo. P. Hampton  
Emma F. Elmore

INVENTOR

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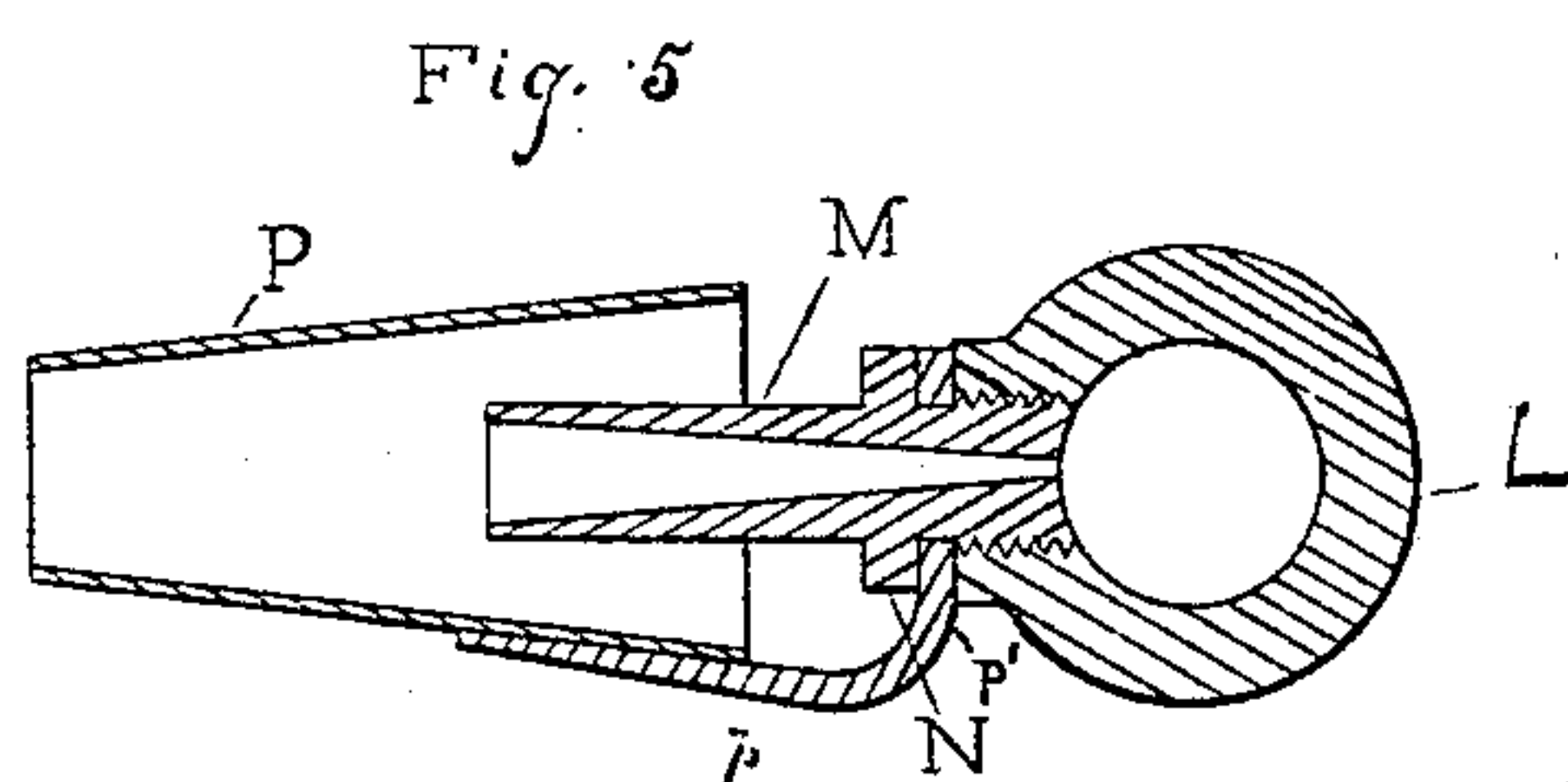
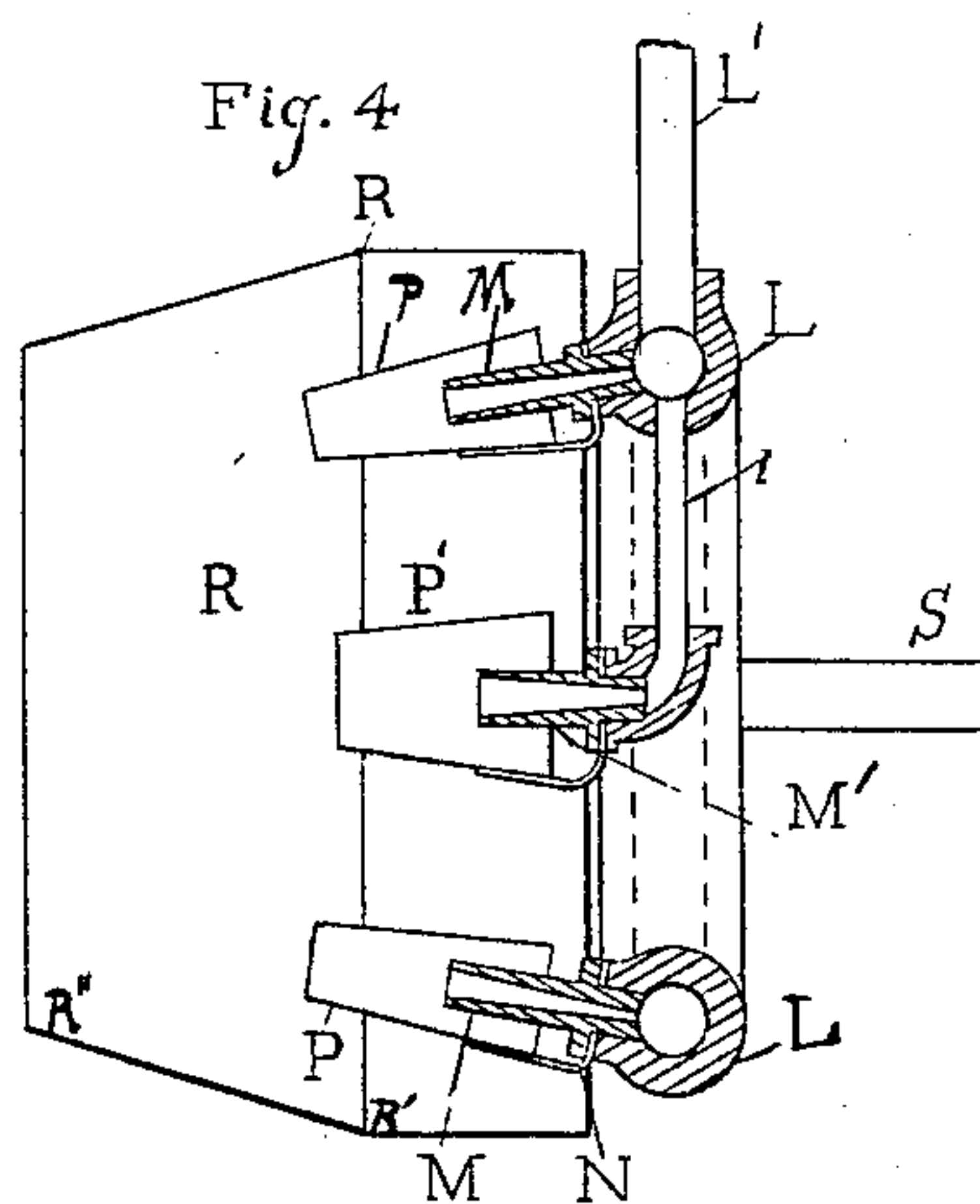
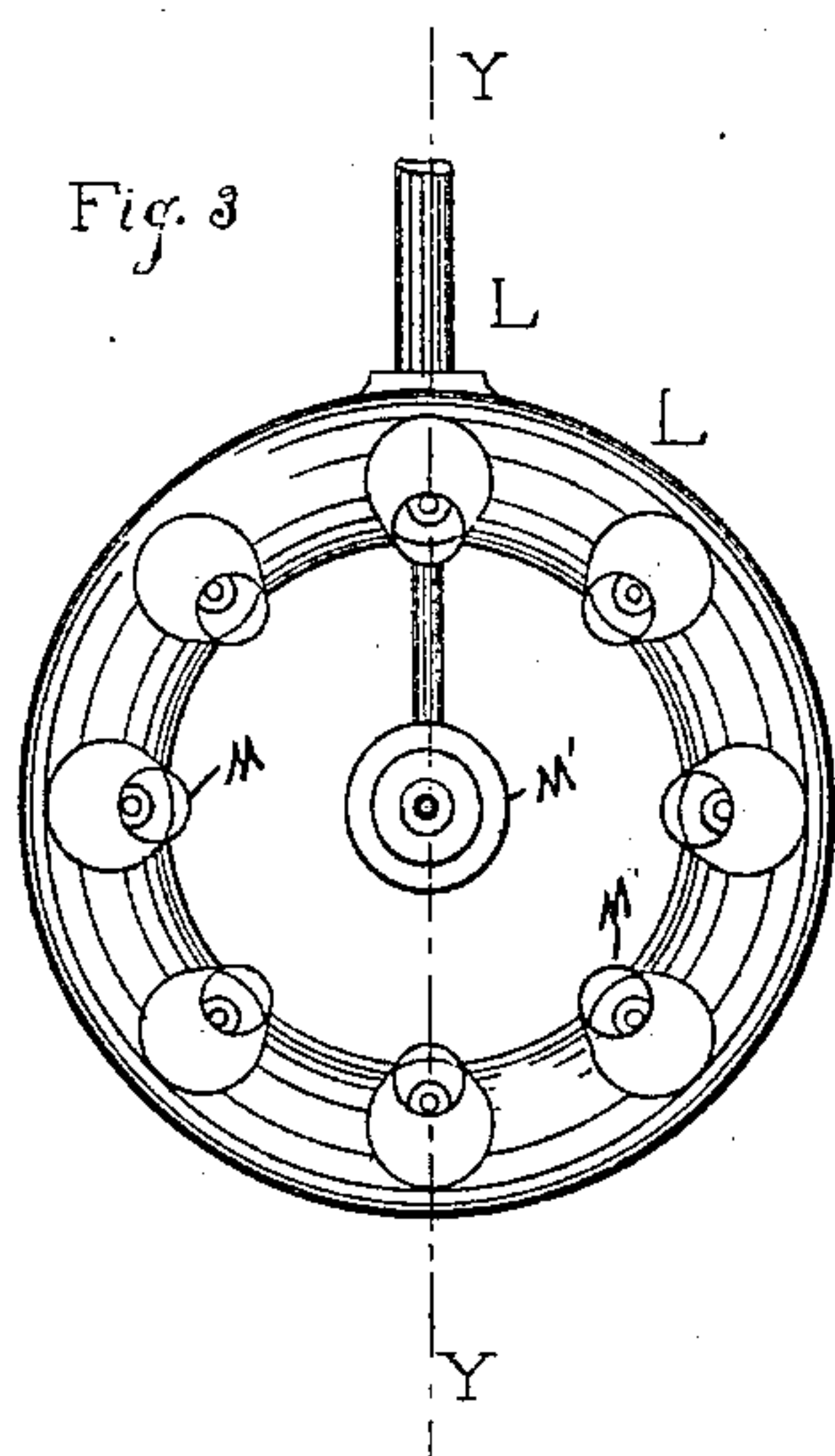
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# UNITED STATES PATENT OFFICE.

THEODORE H. CHAMPION, OF MINNEAPOLIS, MINNESOTA.

## MEANS FOR GENERATING HEAT.

SPECIFICATION forming part of Letters Patent No. 362,935, dated May 17, 1887.

Application filed January 22, 1887. Serial No. 225,194. (No model.)

*To all whom it may concern:*

Be it known that I, THEODORE H. CHAMPION, a citizen of the United States, and a resident of Minneapolis, county of Hennepin, State of Minnesota, have invented a new and useful Improvement in Means for Generating Heat, of which the following is a specification.

My invention is designed more particularly for steam-boiler furnaces, but is widely applicable wherever perfect combustion, economy of fuel, or intensity of heat are desirable objects.

As is well and generally known, there is a great waste of fuel as it is ordinarily used, whether in connection with boilers or for ordinary heating purposes. The combustion is imperfect and incomplete, and a large quantity of heat-producing material passes off in the form of smoke and gases. This is not only a great waste of fuel, but the smoke and gases are a great nuisance in the way of annoyance and as a cause of ill health.

One object of my invention is to overcome these acknowledged defects by effecting the complete combustion of all the carbon in the fuel; but I also take a long step in advance of this by introducing an additional heat-producing element—*i. e.*, hydrogen in the superheated steam, burning it in the fire-box; or, in other words, I draw a part of my fuel from the water in the boiler.

My invention consists, primarily, in introducing under the coal or other fuel a large quantity of thoroughly-commingled air and superheated steam, and, secondly, in means for superheating the steam and for commingling the air and steam and forcing them under the grate and into intimate contact with the coal or other fuel, as is hereinafter more fully described and claimed, reference being had to the accompanying drawings.

In the drawings, like letters referring to like parts throughout, Figure 1 is a side elevation of a steam-boiler furnace with the outside wall removed, showing my improved apparatus in position for work. Fig. 2 is a vertical cross-section on the line X X' of Fig. 1; and Figs. 3, 4, and 5 are details, Fig. 4 being a diametrical section of my injector and combining-tube, Fig. 3 being a perspective of the injector detached, and Fig. 5 being a longitudinal diametrical section of my steam-jet nozzle and combining-hood.

A is the body of the furnace. B is the fire-box or combustion-chamber in the same.

C is the grate.

D is the ash-pit.

E is the boiler. F is the steam-dome on the same.

G is a zigzag coil of steam pipe placed and supported in any suitable way within the fire-box B, preferably on one side of the same, and is provided with an extension, *g*, communicating with the steam-dome F, and another extension, *g'*, leading out through the wall of the furnace and downward for the purpose hereinafter named. The extension *g'* is provided with a stop-cock, H.

K is the blast-conduit or air and steam inlet, leading from the outside of the furnace, where it has an open end for admission of air through the wall of the furnace and into the ash-pit. This open end may be right at the outside of the furnace, or it may be at the end of an extension, K', leading to the outside of the building or to some distant chamber, from which it may be desirable to draw the air.

L is an annular or otherwise suitably-shaped steam-pipe, and is provided with an extension, L', leading to and connecting with the extension *g'* of the steam-superheater G, and L is also provided with another extension, *l*, of smaller diameter leading to the center of the ring formed by the pipe L.

In the pipe L are a series of small screw-threaded holes for the reception and attachment of steam-jet nozzles. These holes are all on the same side of or in the same plane with the pipe L, and have their longitudinal axes inclined slightly toward the center of the ring, or, in other words, at acute angles to the plane of their bases.

M is a steam-jet nozzle whose interior bore is in the form of a truncated cone. The smaller end, M, of this nozzle is provided with a screw-thread and a shoulder, N, as a means for detachably connecting the nozzle to the pipe L. There are a series of these steam-jet nozzles, one being screwed into each of the holes in the pipe L and another, M', being attached to the end of the extension *l* of the pipe L in the center of the ring. The bore of this central nozzle, M', has an area in cross-section three times as large as that of any of the other nozzles.

P is an air and steam commingling hood.



It is in shape like a truncated cone, and is supported over and incloses the outer and larger end of the nozzle M. It is supported in proper position in any suitable way, as by the bracket 5  $p p'$ , held between the shoulder N of the nozzle and the pipe L. The hood P', over the central nozzle, is larger in area and shorter than the others.

R is a large adjustable air and steam combining and regulating tube, consisting of the cylindrical part R' and the part R'' in shape like a truncated cone. The part R' is of a size to fit snugly within the blast-conduit K at its point of passage into and through the furnace-wall. The part R'' has its base attached to 15 the cylinder R', and its truncated apex in the direction of the ash-pit, and is, by preference, considerably longer than the part R'. The area of its outlet should vary according to the particular furnace, or, in other words, according to the quantity of air and steam it is desired to introduce. This combining-tube R is longitudinally adjustable, in order to bring the injector nozzles nearer to or more remote from 20 its outlet, and thus increase or decrease the quantity of air taken in with the steam. The nearer the nozzles of the small injectors are to the outlet of the combining-tube the less air, other things being equal, will be taken into 25 the ash-pit. As a means of effecting this adjustment of R, the handle S is shown in the drawing; but of course it will be understood that any other suitable means may be used.

The hood P', over the central nozzle, M', is 35 of about twice the area in cross-section of any of the others, the steam-jet nozzle contained thereon being, as before stated, three times the others in area, and this central hood is also shorter than the others. This difference 40 in size between the central and the other small injectors is a very material point. By this construction the central nozzle serves as an injector for the air and steam combined and converged toward a focus by the other small 45 injectors, and induces with it a large quantity of air through the central space of the ring. Without the central nozzle comparatively little air will be taken in through the central space, and the combined air and steam from 50 the other small injectors will not be forced forward so rapidly nor be so thoroughly commingled with the air.

The part R' of the combining-tube R is larger in diameter than the ring formed by the steam-pipe L. This allows the induced currents of air to pass freely into the combining-tube outside the pipe L and the injector-nozzles, as well as through the central space and the spaces among the nozzles.

60 The ash-pit D is an air-tight ash-pit closed at all points, except through the conduit K.

The shape of my small injector-nozzle in and its combination with the peculiarly-shaped hood P is considered a very material part of 65 my invention for commingling the air and steam. The steam entering the nozzle at its small end expands as it moves outward, and

its particles leave the nozzle on divergent lines, while, owing to the peculiar shape of the hood, the air induced by the steam enters 70 the hood on convergent lines; hence the air and the steam are bound to interpenetrate or cross each other's paths in the upper part of the hood and become thoroughly commingled. Moreover, the steam has a far higher air-in- 75 ducing power in virtue of its leaving the nozzle on divergent lines; hence more air is drawn in. By varying the number of these small injectors and the size of the central injector and the outlet of the combining-tube any 80 quantity of steam and air desired may be thoroughly commingled and forced under the grate and into contact with the burning coal or other fuel.

The operation is clear from the description 85 already given. Live steam passes from the steam-dome to the superheater, where it is superheated to a high degree of temperature. Thence it passes out on divergent lines through the steam-jet nozzles, drawing in an immense 90 quantity of air. The air and steam are thoroughly commingled by the compound injectors and combining-tube, and the air is heated. In this hot and dry condition the mingled body of air and steam is delivered under the ash-pit, 95 and is forced by the continuous pressure in its rear upward through the burning fuel and into intimate contact with all parts of the same. Oxygen is supplied in such abundance that every particle of the carbon is seized upon and 100 made to combine with a part thereof, effecting complete combustion, while the superheated steam, being dry and hot, the hydrogen therein takes fire in passing through the fuel, combining with another part of the great abun- 105 dance of oxygen, giving off most intense heat. Every heat-giving element is utilized. The watery vapor formed by the burning of the hydrogen is instantly converted into steam, and is in part absorbed by the ashes and in 110 part passed off up the chimney.

I have had my process and improved apparatus in use for some months, and by actual experience on a large scale I get over double the amount of work with the use of any given 115 amount of coal. I attribute this great increase in valuable result to three things, viz: first, the fact that I introduce the steam and air under the grate thoroughly commingled and very hot and dry, avoiding any waste of fuel in absorbing 120 moisture or heating air; second, the presence of great abundance of oxygen effecting complete combustion of the carbon; third, the supplying and burning of the hydrogen. I make water-supply a large part of my fuel. This could not 125 be done without the preliminary thorough mixing of the air and hot-steam. The constituent elements must be brought into intimate relations—within the range of chemical affinity—in order to perfect chemical action. This must be 130 done under the fuel and not over it. My compound injector I design especially to effect this perfect mixture and to force the commingled mass forward and into intimate contact with



the ignited coal or other fuel, and I consider it the best means of applying my process.

In case certain kinds of coal are used in the furnace—viz., those varieties of coal which are peculiarly liable to clinker—it may be desirable to use live steam, either intermittently or continuously, to moisten and soften up the coal and prevent clinkers. In that case I provide a steam-pipe leading directly from the steam-dome to the pipe L. It is serviceable to have this extra live-steam pipe even where the superheated steam is used virtually all the time, as it is useful at intervals for cleaning out the grate. I attach this extra steam-pipe to L or L' below the stop-cock in *g'* and provide it with a stop-cock. Moist steam or superheated steam may thus be used at will.

My compound combined air and steam injector and commingler is alike serviceable whether moist steam or superheated steam is used. This will work in a measure when the ring L, with its steam-jet nozzles M, is suitably set in the conduit K. It will work better when the combining-tube R is added; and with the hoods P and the tube R and the larger central nozzle and hood it works to perfection.

It will be readily understood that my invention is applicable to all kinds of furnaces used in the reduction of ores and metal-working, and to all kinds of house-heating furnaces and common stoves, (if a supply of steam be available,) as well as to the boiler-furnace shown and described. It is capable of a very important use as a means of ventilation. As is well known, little or no fresh air can be put into a room until the foul air is taken out. By adding an extension to my blast conduit K (as K' in the drawings) and having its air-inlet end terminate through registers in the bottom of the room, or by divergent branches to different rooms, a large hall or the various smaller rooms of a building may be exhausted of foul air. Add a supply of fresh air (warmed or cooled, if desired, beforehand) and complete ventilation is effected.

What I claim, and desire to secure by Letters Patent of the United States in this application, is as follows:

1. In combined steam and air injectors for furnaces and similar uses, a longitudinally adjustable combining and regulating tube inclosing said injector, whereby the relative quantities of steam and air introduced and the degree of commingling may be varied.

2. In boiler-furnaces, a steam-superheater, a blast-conduit from the air to the ash-pit, an adjustable combining and regulating tube within said conduit, and a combined air and steam injector within said combining-tube, in combination, substantially as and for the purpose described.

3. In boiler-furnaces, a blast-conduit leading from the air to the ash-pit, an adjustable air and steam combining and regulating tube within said conduit, a compound air and steam

injector within said combining and regulating tube, a steam-superheater consisting of a steam-pipe coil within the fire-box, provided with an inlet-extension communicating with the steam-dome, and an outlet-extension communicating with the said injector, and means for controlling the supply of steam from said steam-superheater, substantially as described.

4. In boiler-furnaces, a blast-conduit leading from the air to the ash-pit, an adjustable air and steam combining and regulating tube within said conduit, a compound air and steam injector within said combining and regulating tube, and a steam-pipe leading from the steam-dome to said injector with or without a steam-superheater intermediate said dome and said injector, substantially as described, whereby superheated steam or moist steam, at will, may be commingled and forced under the ignited fuel.

5. In combined steam and air injectors for furnaces, a steam-jet nozzle in shape like a truncated cone, with its smaller end in communication with the steam-pipe, and an air and steam commingling hood in shape like a truncated cone placed and supported with its larger end over the outlet end of said steam-jet nozzle, whereby the air is induced on convergent lines and meets and crosses the paths of the particles of steam moving on divergent lines, and thorough commingling is effected.

6. In steam and air injectors for furnaces, steam-jet nozzle M, in shape like a truncated cone, with its larger end for its outlet, hood P, in shape like a truncated cone, placed with its larger end over the outlet of nozzle M, bracket *p p'*, and the steam-supply pipe L, in combination, substantially as described.

7. A combined steam and air injector for furnaces, consisting of the annular steam-supply pipe L, with extension L' to a source of steam, a series of steam-jet nozzles, M, in shape like truncated cones, with the larger end for steam-outlet, and a series of hoods, P, in shape like truncated cones, supported each with its larger end inclosing the outlet of the steam-jet nozzle, in combination, substantially as described.

8. In furnaces, in combination, the compound combined steam and air injectors L M P M' P', as described, combining and regulating tube R, as described, steam-supply L', leading to a source of steam, and blast-conduit K, substantially as described.

9. In boiler-furnaces, in combination, the compound combined steam and air injector L M P M' P', as described, combining and regulating tube R, as described, steam-superheater G, steam-supply pipe *g*, and communicating-pipes *g' L'*, boiler E, with dome F, blast-conduit K, closed ash-pit D, a grate, C, and fire-box B, all substantially as described.

THEODORE H. CHAMPION.

In presence of—

JAS. F. WILLIAMSON,  
EMMA F. ELMORE.