(No Model.) 2 Sheets—Sheet 1.

C. GORTON.

STEAM GENERATOR.

No. 257,217. Patented May 2, 1882.

Fig. 1.

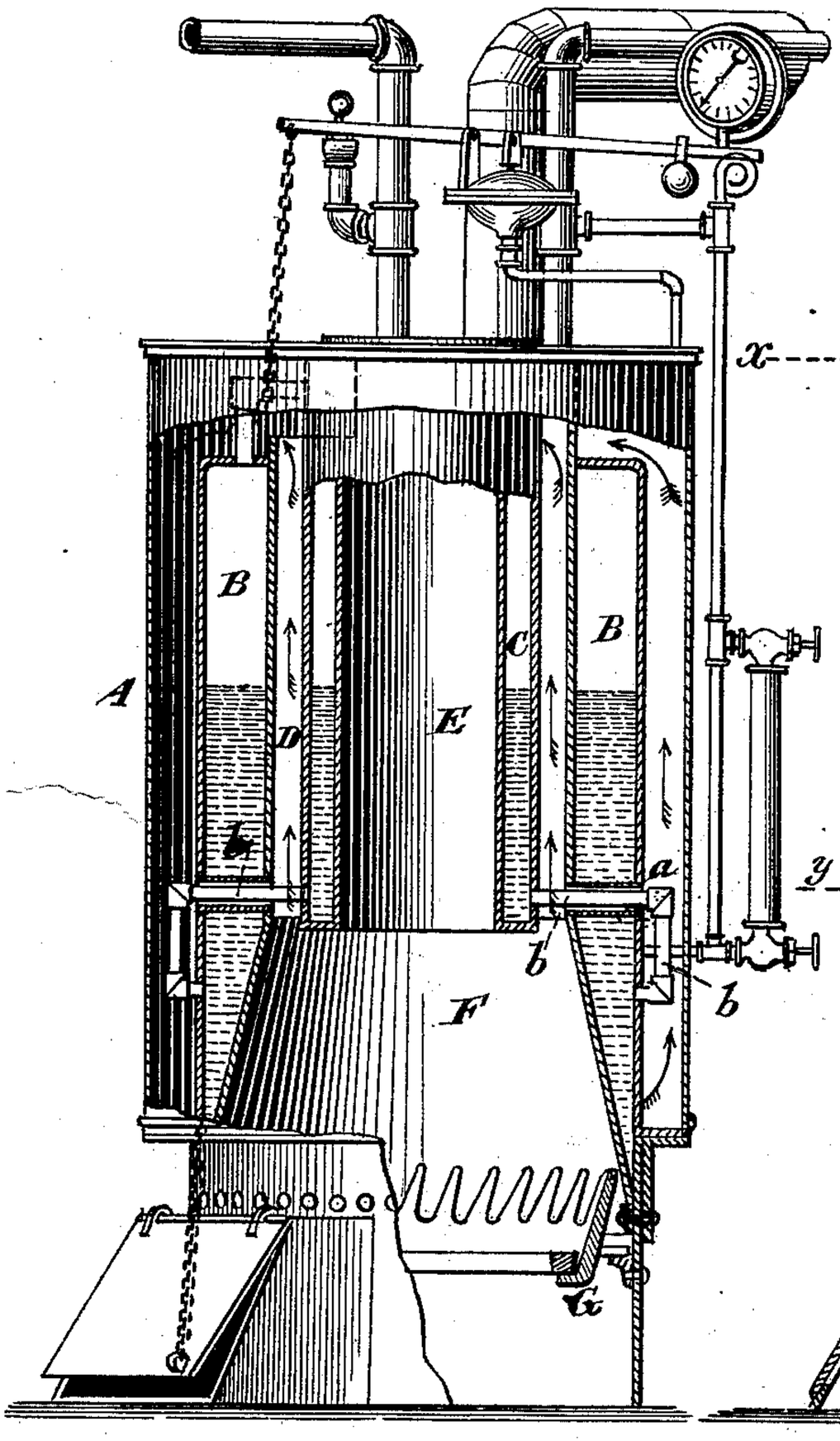
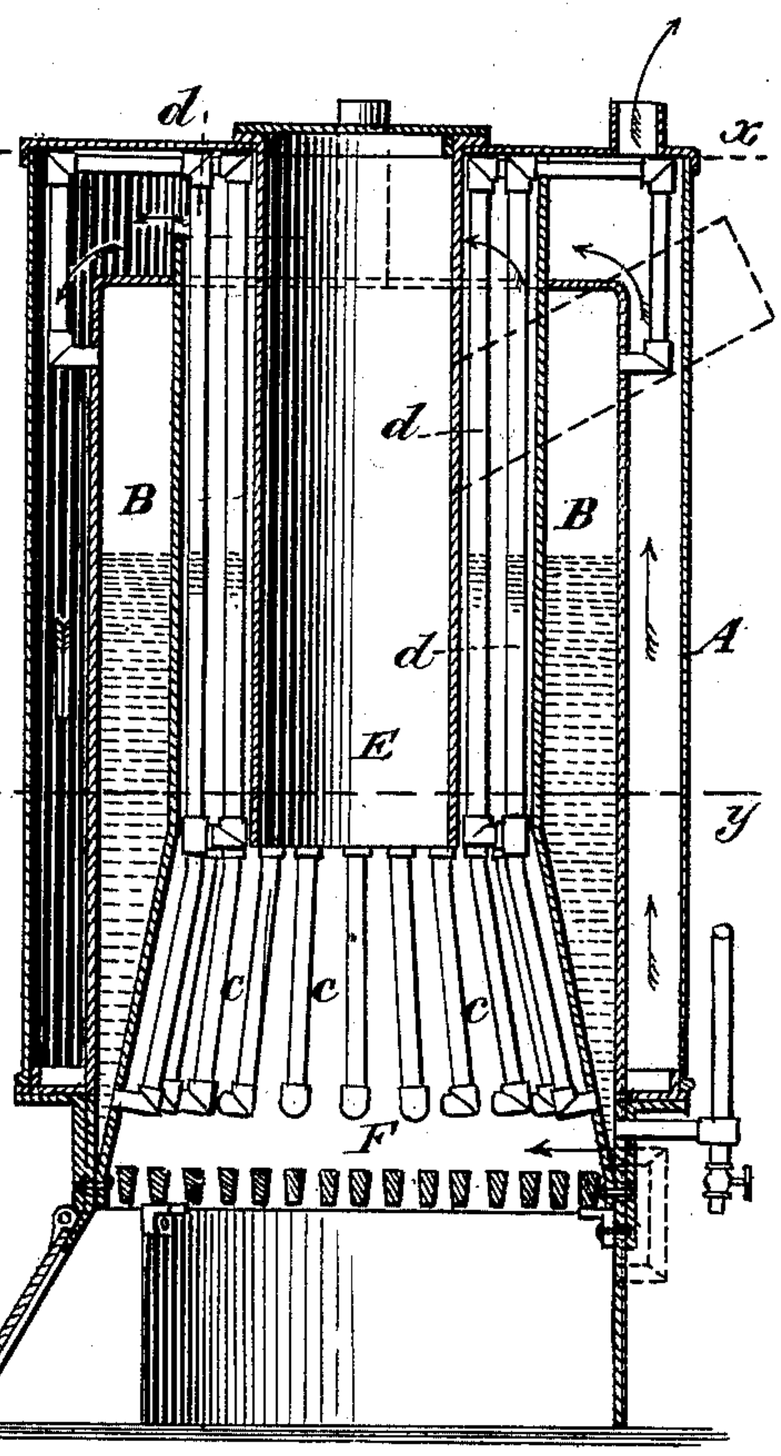


Fig. 2.



Witnesses.
A. Ruppert.
James Jones

Inventor.
Charles Gorton

(No Model.) 2 Sheets—Sheet 2.

C. GORTON.

STEAM GENERATOR.

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Fig. 3.

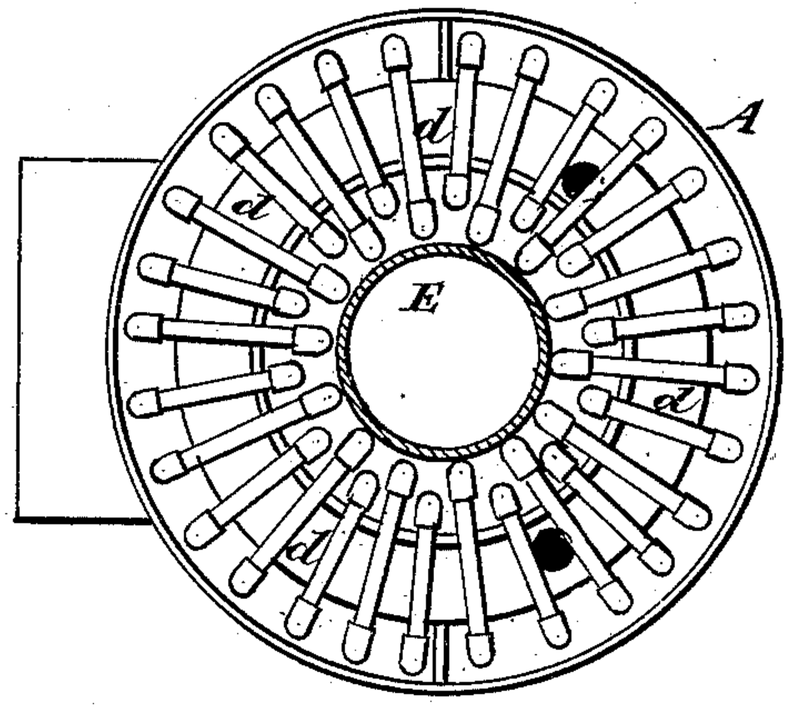


Fig. 4.

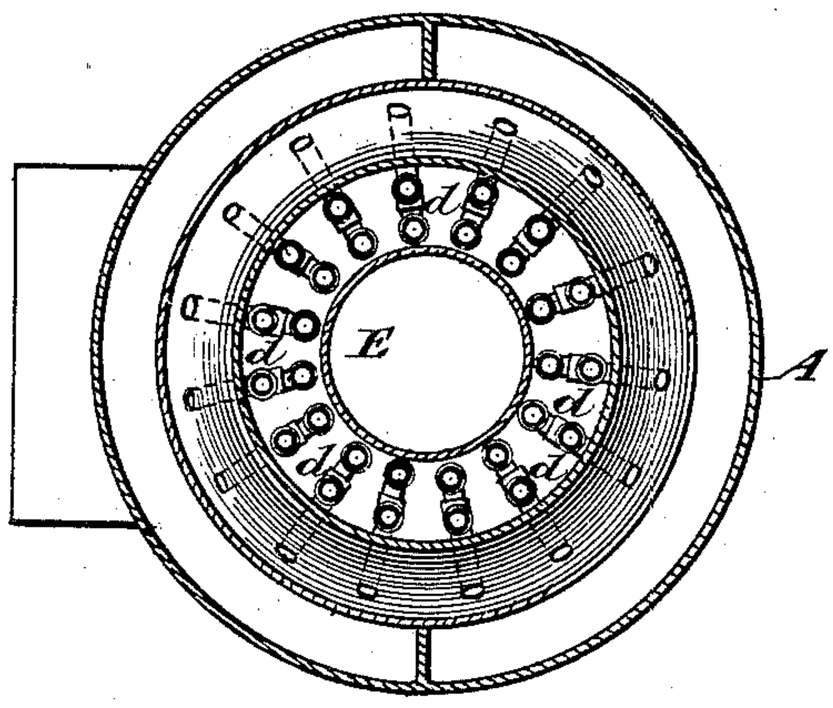
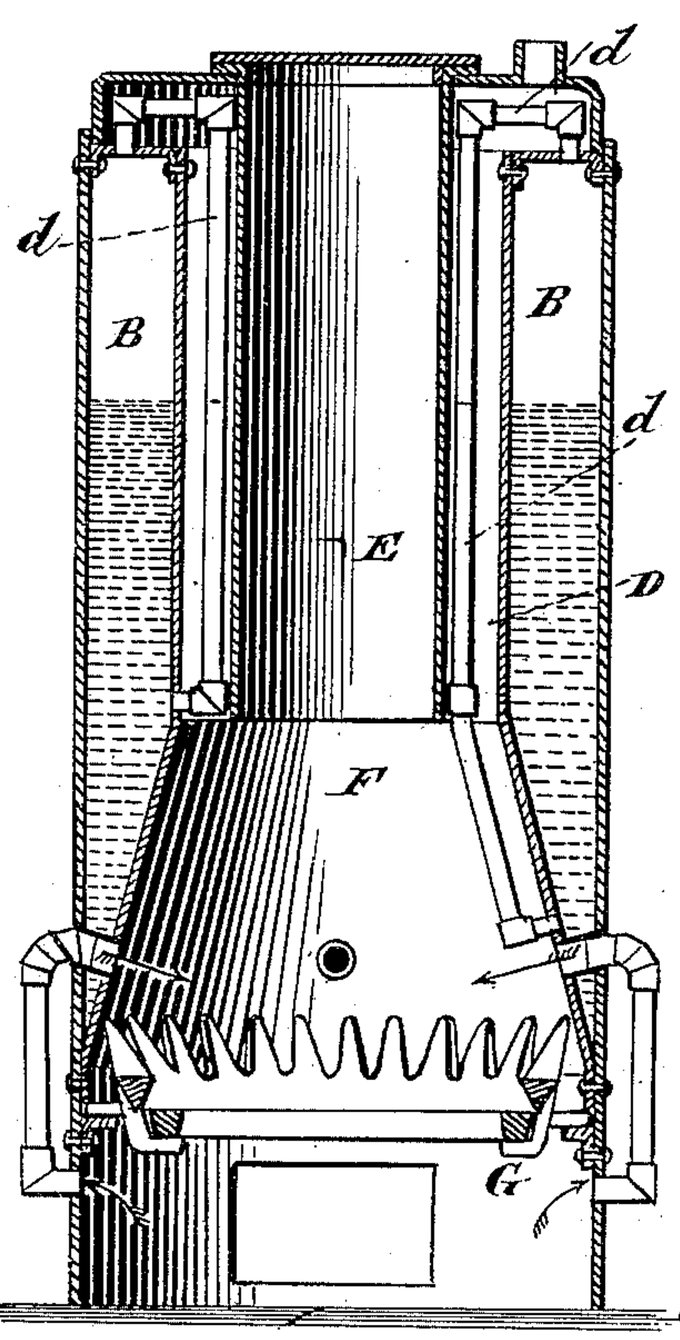


Fig. 5.



Witnesses.
A. Ruppert A.
James Jones

Inventor:
Charles Gorton

UNITED STATES PATENT OFFICE.

CHARLES GORTON, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 257,217, dated May 2, 1882.

Application filed March 22, 1882. (No model.)

To all whom it may concern:

Be it known that I, CHARLES GORTON, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in the construction of steam-boilers having for its object the diminishing of the consumption of fuel, the better and more economical heating of the water or other liquids or contents, the attainment of a greater regularity of the dispersion of the heat and circulation of the water into steam, and the greater diminution of first cost and facility of repairs.

To these ends it consists in constructing the boiler with a central reservoir for fuel, arranged in such manner that the shell forming the reservoir is readily removable, and is suspended concentrically within a circle or circles of tubes, which extend from the fire-pot to the top of the boiler. These tubes connect both with the water and steam space thereof.

It further consists in combining with the said circular circles of tubes another series of tubes, extending down and along the wall of the fire-box and connecting thereto, their upper ends connecting to the said upper series by suitable steam-connections, the lower series forming a lining for the fire-chamber and a space between the water-walls of the fire-box and the tubes, whereby when the combustion-chamber is completely filled with fuel the said space gives opportunity for the gases evolved from the fuel to thoroughly mix and commingle with the atmospheric air to such a degree that the ignition of the gas thus formed readily takes place before it has time to form smoke, the tubes forming an increased and rapid generating-surface.

It further consists in certain devices by which the requisite quantity of air is supplied to the combustion-chamber, and in such manner that the supply is automatic and in regulated quantities, either above or below the fuel, or either or both; and it finally consists in forming an enlarged flue or flame space between the fuel-reservoir and the annular water-space, in which flame-space are located generating and circulating tubes, the said tubes being so arranged that all the products of combustion are made to impinge against the surface of said tubes, thereby impeding the exit of the heat to a sufficient extent as to be transmitted to the water in the tubes, and in other details of construction, as will more fully hereinafter appear.

Such being the nature and object of my said invention, I will now proceed to describe the manner in which the same may be carried into effect, and in order that the invention may be completely understood I will refer to the accompanying drawings, in which—

Figure 1 illustrates a vertical longitudinal section of a boiler generally embodying my principle of construction, showing a grate and what I term a "fingered" or "scalloped" annular air-ring. Fig. 2 shows a similar construction, only having an ordinary grate. In this instance the tubular lining for the fire-box and reservoir are shown, and which form the gist of this invention. Fig. 3, a plan view of the boiler on the line *x x*, Fig. 2, looking from the top, the lid or cover being removed. Fig. 4 represents a horizontal transverse section taken on the line *y y*, Fig. 2, clearly showing a double row or two circles of tubes and their relative position to the fuel-reservoir. Fig. 5 shows another plan, in vertical longitudinal section, of a boiler without the outer jacket or casing. In this figure air-tubes communicating with ash-pit and combustion-chamber are plainly shown, although it is evident that these air-tubes may be applied to any of the plans described. I prefer that these tubes should communicate with the air-chamber of the ash-pit, for the reason that when the draft from below is controlled the supply of air passing through the air-tubes is also controlled.

The same letters will indicate like parts in all the figures; but I will describe each of the figures separately for the better understanding of the general principle involved and the means employed whereby the same may be practically carried into effect.

Referring to Fig. 1, A is the outer shell, between which and the plate of the boiler is found a flue-space. This space is divided horizontally and vertically by partitions across the

top and sides in such manner as to compel the hot products of combustion to descend on one side of the boiler and ascend on the other, thus causing the hot gases to travel three times through the boiler, each time being in close contact to the generating-surface. Hence it will be seen that nearly all the heat is extracted and transmitted to the water before the escape of the fire products to the atmosphere.

B is the outer water-space, and C the inner water-space, both being preferably annular in cross-section. A flame space or flue, D, is formed between them, through which the flame passes.

E is the coal-reservoir, and is formed by the inner walls of the inner water-chamber, and which terminates at the bottom at the crown of the furnace, but extends above the outer water-space and up to the top of the boiler.

F is the furnace or fire-box, which is somewhat the shape of the frustum of a cone, forming an angular water-space in cross-section and terminating below the fire-place, the outer walls being parallel in vertical section and the inner walls converging to the center, where they terminate in joining the inner wall of the outer water-space, and which wall forms the inner wall of the flame-flue D of said water-space.

Just above the crown of the furnace I provide a thimble or hollow stay-bolt, *a*, the object being twofold—first, to stay the boiler-shells, and, secondly, to provide means for the passage of the circulating and supporting tubes *b*. These tubes also perform a double function—*i. e.*, that of circulation from the outer water-space to the inner water-space, and also to retain the inner water-space in position.

Near the top of the boiler, and within the return flame-flue, I form another connection between the inner and outer chambers; but in this case the connections are for steam communication, so that the pressure in both chambers may be equal. This is done by L-shaped pipes running from the side of the inner chamber to the top of the outer chamber. Here the magazine or fuel-reservoir is capable of acting in a double capacity—viz., that of forming a continuous fuel-magazine and affording ready access for the pipe-connections, by which circulation is provided for and the sustaining of the two water-vessels in position.

Near the termination of the water-space, at the bottom of the boiler, I locate my grate, but preferably rest it upon a casting, G. This casting is provided with an annulus for holding the grate in position; but its important feature is to supply air to the fuel, and particularly when the interstices between the grate-bars are choked with ashes. I construct this casting G pan-like, somewhat flaring at the top, and provided with what I term "fingers;" but it may be serrated, scalloped, or perforated, so that air may be supplied in sufficient quantities for the nearer perfection of combustion of the fuel used. Now, it often happens that too much air for the economical combustion of fuel is admitted to the combustion-chamber, and, again, the supply is very deficient, for the reason that the space for the supply is inadequate to the demand. For this reason I construct the fingered casting in an upward and outward inclining form, so that when in position the conical form of the wall of the fire-box and the inclination of the casting will form an annular angular air-space between the said wall and the casting. Therefore, the body of air striking these double inclines will force it, injection-like, through the orifices between the fingers, and thus supply the necessary oxygen for the proper combustion of fuel. Furthermore, the air is partially heated, while in contact with the hot fingered casting, before its admission to the fire-box, and does not therefore have the chilling effect that cold air from outside would have.

Steam-pressure gages, damper-regulators, and other essential attachments are shown, but form no part of this invention.

I will now proceed to describe Fig. 2. The outer shell, the outer water-space, and the fire-box are substantially the same as that described for Fig. 1, the difference, however, in the two methods of construction being that, instead of the inner water-chamber shown in Fig. 1, I employ a double series of tubes, and are arranged in the following manner: Just above the grate, and within the fire-box, I connect a series of pipes, *c*, in any approved manner. These pipes extend to and terminate near the crown of the furnace, and as they approach said termination they come closer together by the reason of the conical form of the fire-box. These tubes extend the entire distance around the fire-box and connect into what are known as "T" connections or fittings, only that the openings are all of them one in the same vertical line, so that the tubes *c* connect into the lower part of said fittings. From these fittings extend to the top of the boiler a double row of tubes, *d d*, the end of each being suitably fastened into the branch T, as clearly shown at Fig. 4. They are then again connected by L-fittings to another pipe in the return flame-chamber, which may enter the side of the outer water-chamber, B, or into its top, as may be seen at Fig. 1. The manner of arranging these tubes in the upper portion of the boiler leaves a central opening, and into this opening I insert a fuel reservoir or magazine, which extends to or below the vertical tubes, and which simply fits the said opening, and which not only forms the fuel-magazine, but forms a brace for retaining the tubes in position. As before stated, these tubes, with those forming the tubular lining of the fire-box, make a vast heating-surface. They are in the position to receive the fierce heat of the fire and the heat impinging upon them from all sides. They form an extensive heating-surface. These tubes are easily fitted, removed, and replaced. They, being the same size and length, are interchangeable, as, in fact, all parts of the boiler are, so that when any of the parts become worn

they may be readily replaced without taking the whole boiler to pieces.

Should it be desirable or required, a side chute may be employed to supply the fuel to the reservoir, as may be seen in dotted lines in Fig. 2.

It is evident that air may be supplied to the fuel above the grate from the ash-pit by means of tubes, as shown and as before described; and, also, the well-known boiler attachments in general use may be furnished to my tubular boiler, as illustrated in Fig. 2.

Figs. 5, 3, and 4, respectively, are transverse sections taken on the lines *x x* and *y y* of Fig. 2.

Before passing from Figs. 2, 3, and 4 I desire to have it particularly understood that the gist of my present invention lies in the principle demonstrated by these figures, and believe that this style of boiler is the best, will generate more steam with less fuel, is cheaper in first cost and less liable to get out of repair, will last longer, and give more general satisfaction than any known to me.

Fig. 5 is an illustration of a very simple form of boiler without the outer casing and the return-flue principle, but substantially embodying the construction laid down for Fig. 2.

It often happens that in the country, where weight is of great consideration, where the boiler is mounted on wheels and the ground is soft, and where there is no roadway, if heavy, the boiler cannot be moved from place to place, as usually is very necessary for thrashing, stump-extracting, cooking food for cattle, and particularly in the South for sugar-cane-juice boiling and in the West for steam-plowing. For such purpose heavy boilers are unsuitable, and, moreover, when the first cost of a boiler is of great consideration to the farmer, and where fuel is very plenty, this form of boiler is the most simple of any I ever saw. In constructing this boiler I have had in view the requirements of farmers generally, not only as agricultural necessities proper, but where saw-mills are used, tanneries, sugar-cane, &c. Where sawdust, tan-bark, cornstalks, &c., are in the way and can be utilized as fuel, this boiler is peculiarly applicable. All these fuels and such trash require a large amount of air for their combustion, both above and below the grate, for the reason that when thrown into the furnace they pack very close and make it difficult for the air to pass through. Hence the fingers of the fingered casting open an air-space otherwise unattainable. The air-tubes from the ash-pit supply air into the body of the fuel, and the flame passing up direct in close contact with the shell of the fuel-reservoir dries the fuel for ignition as soon as it reaches the fire-chamber, and the tubes surrounding the fuel-magazine permit free access to the air and unobstructed draft, and at the same time present a large heating, generating, and circulating surface. Of course the furnace is well adapted to coal or to any of the ordinary fuels used, but is at the same time useful to the fuels above mentioned.

It is obvious that modifications can be very readily made within wide range of my inventions, and I do not therefore wish to be confined to the exact form shown. Therefore,

Having shown and described the forms at present preferable, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a steam-generator, of a boiler composed of two independent cylindrical sections concentrically arranged in such manner that an annular flame-space is formed between them their entire length, the inner cylinder forming a fuel-magazine and terminating at the crown of a conical fire-chamber, said chamber having at its lower end or base a casting provided with fingers or serrations flaring upward in opposite directions from the downwardly-diverging conical fire-box, whereby an angular air-space is formed for the better supply of air to the fuel above the grate when the latter is choked with ashes, substantially as described.

2. The combination, in a vertical steam-generator, of an outer water-space angular in transverse section at its base, the inner wall diverging outwardly and forming a conical fire-chamber, and a circle of tubes forming a fire-lining for said chamber, said tubes encircling the base of a fuel-magazine at their upper ends, in the manner shown and described.

3. The combination, in a steam-boiler, of the outer water-space with a central fuel-magazine, the single series of water-tubes forming the fire-box lining, and the double nest of tubes interposed between the fuel-magazine and the outer water-space, and connecting with the lower tubes, whereby a rapid circulation of water is maintained and an increased generating-surface produced, in the manner set forth and described.

4. In a steam-generator of the vertical type, an outer water-space provided preferably at its bottom with a conical combustion-chamber, a central magazine, a series of circulating and generating tubes annularly arranged between the water-space and the magazine, and a fingered or serrated casting surrounding the grate, with or without the air-supplying tubes, all arranged and combined in the manner and for the purpose set forth.

5. In a steam-generator of the vertical type, an outer water-space provided at its bottom with a conical combustion-chamber, a central magazine, and a series of circulating and generating tubes annularly arranged between the water-space and the magazine, said series of tubes extending down and forming the fire-box lining, substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

CHARLES GORTON.

Witnesses:
JAMES JONES,
M. P. CALLAN.