(No Model.)

4 Sheets—Sheet 1.

T. GREEN.

STEAM GENERATOR.

No. 344,268. Patented June 22, 1886.

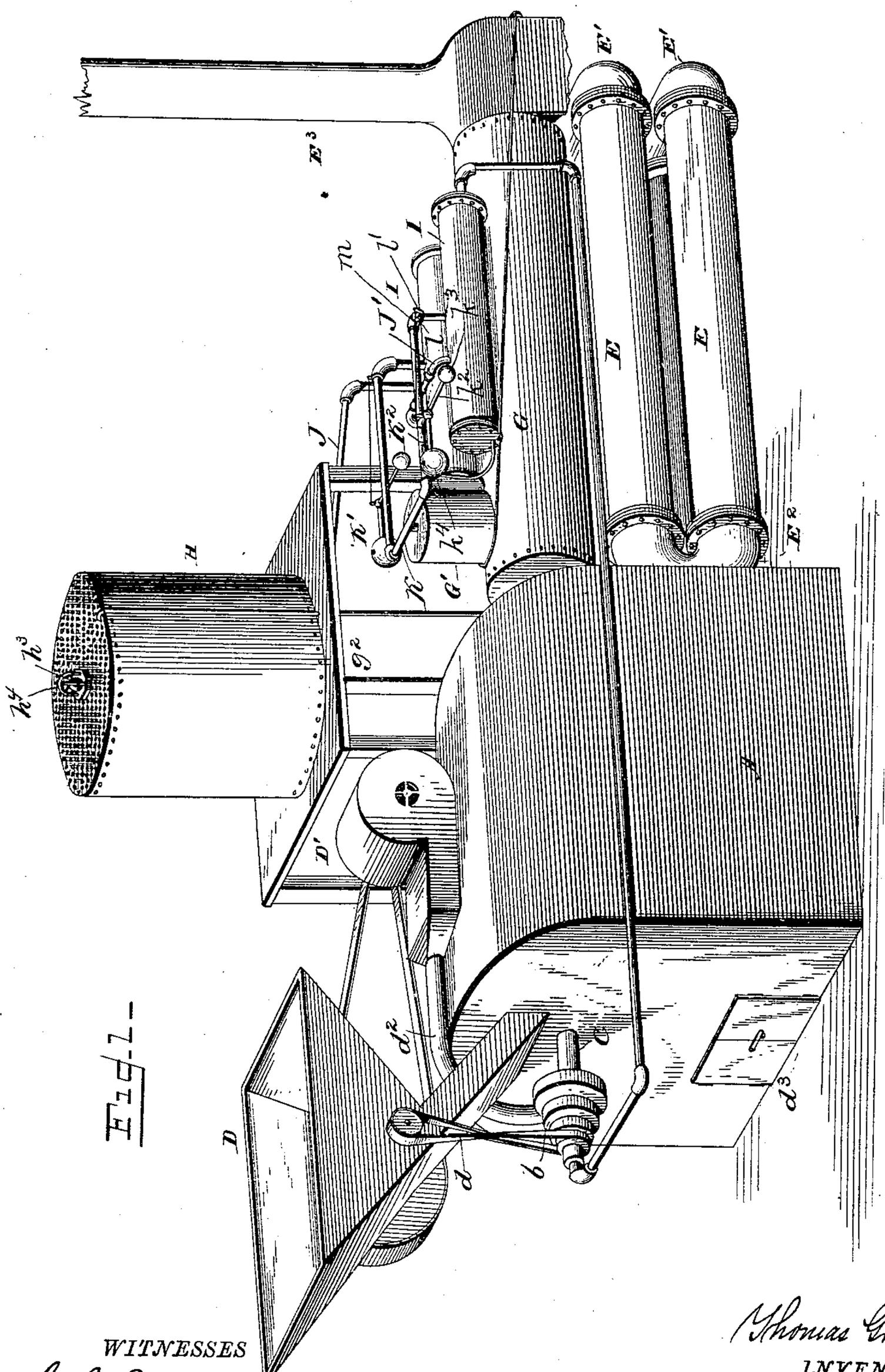

Fig. 1.

WITNESSES

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(No Model.)

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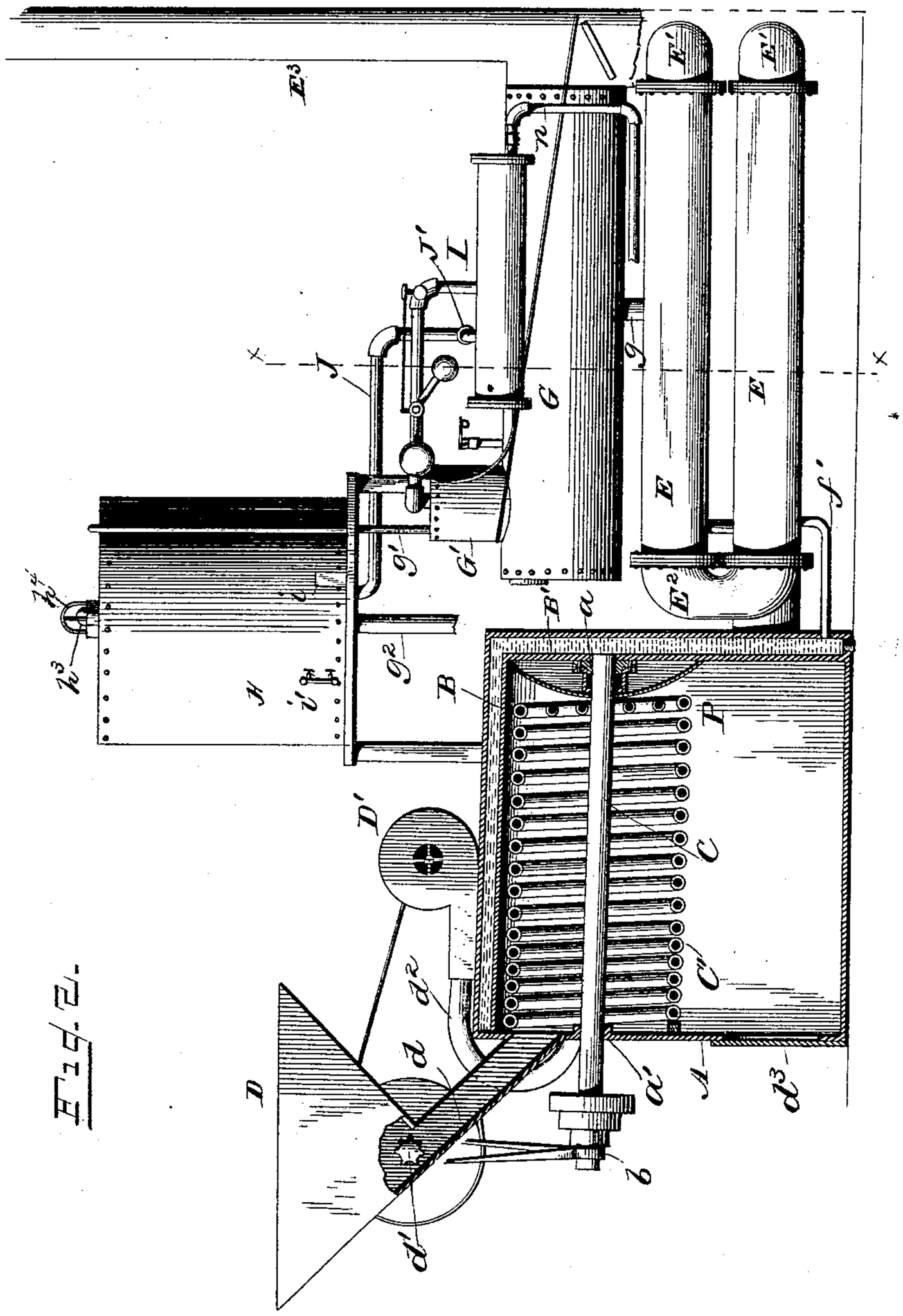

Fig. 2.

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Fig. 3.

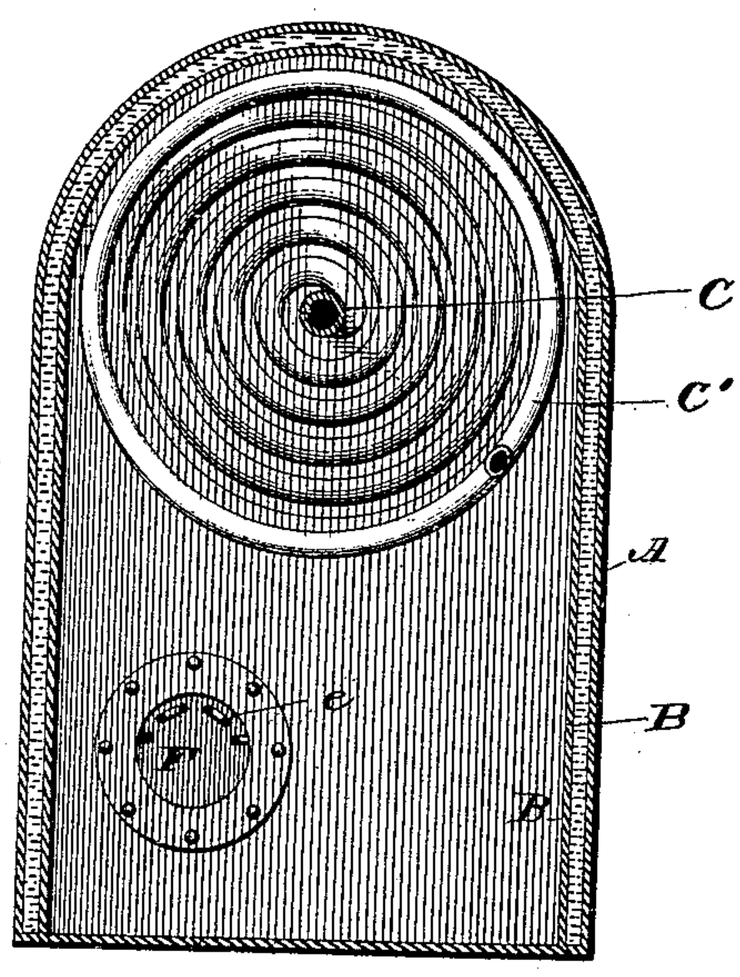
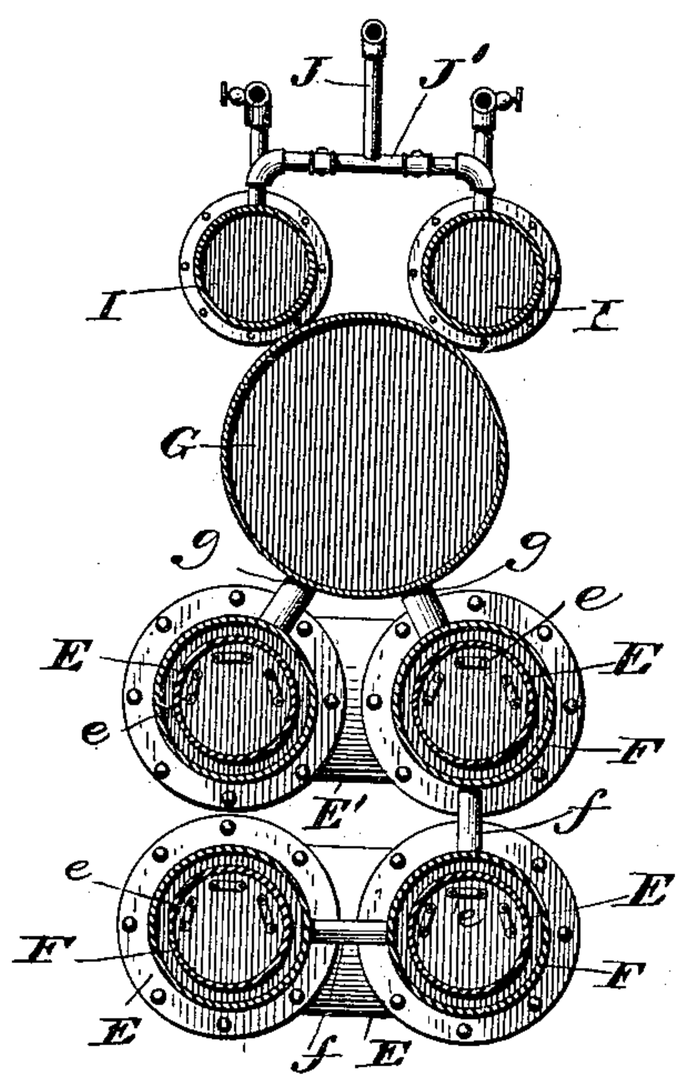


Fig. 4.



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4 Sheets—Sheet 4.

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Fig. 5.

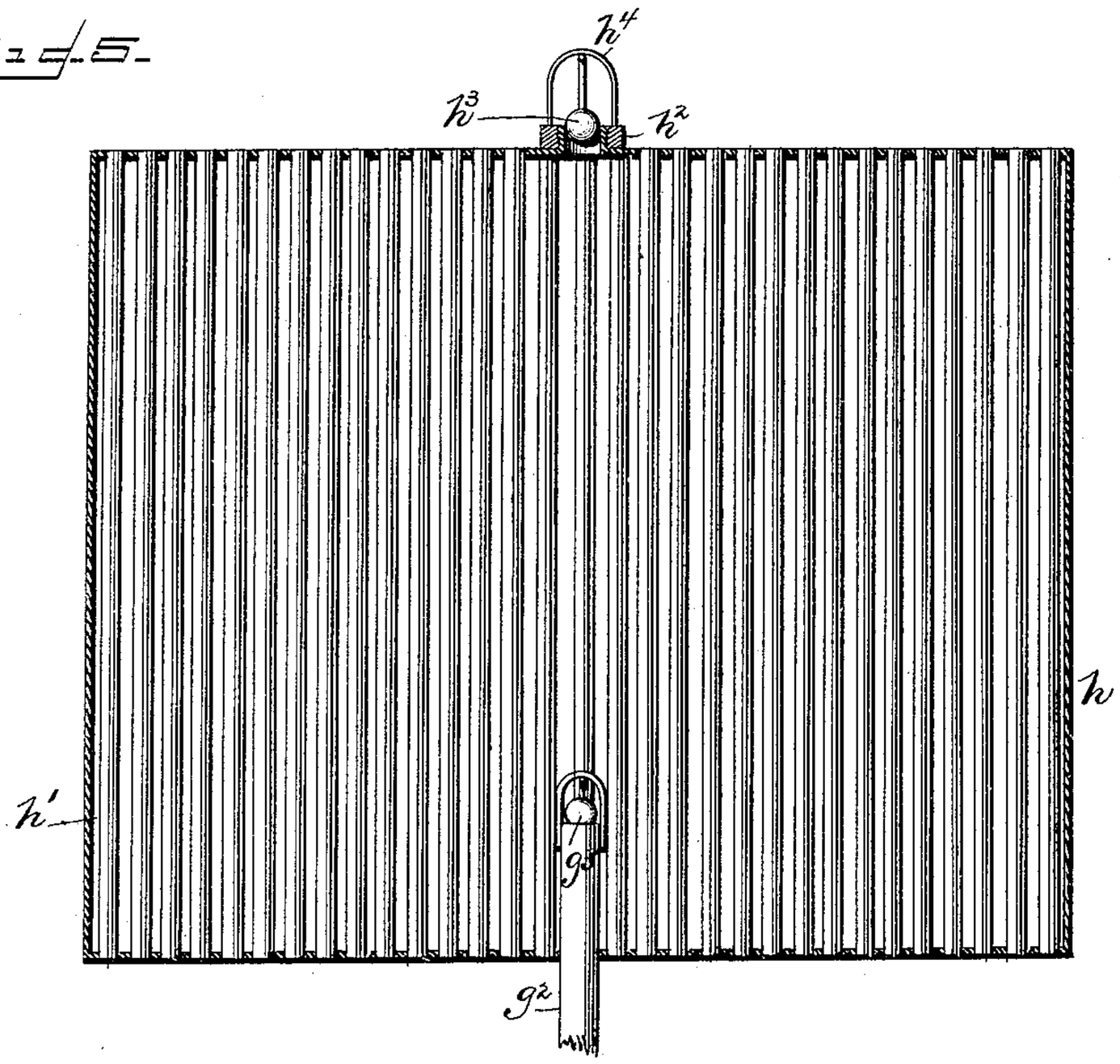
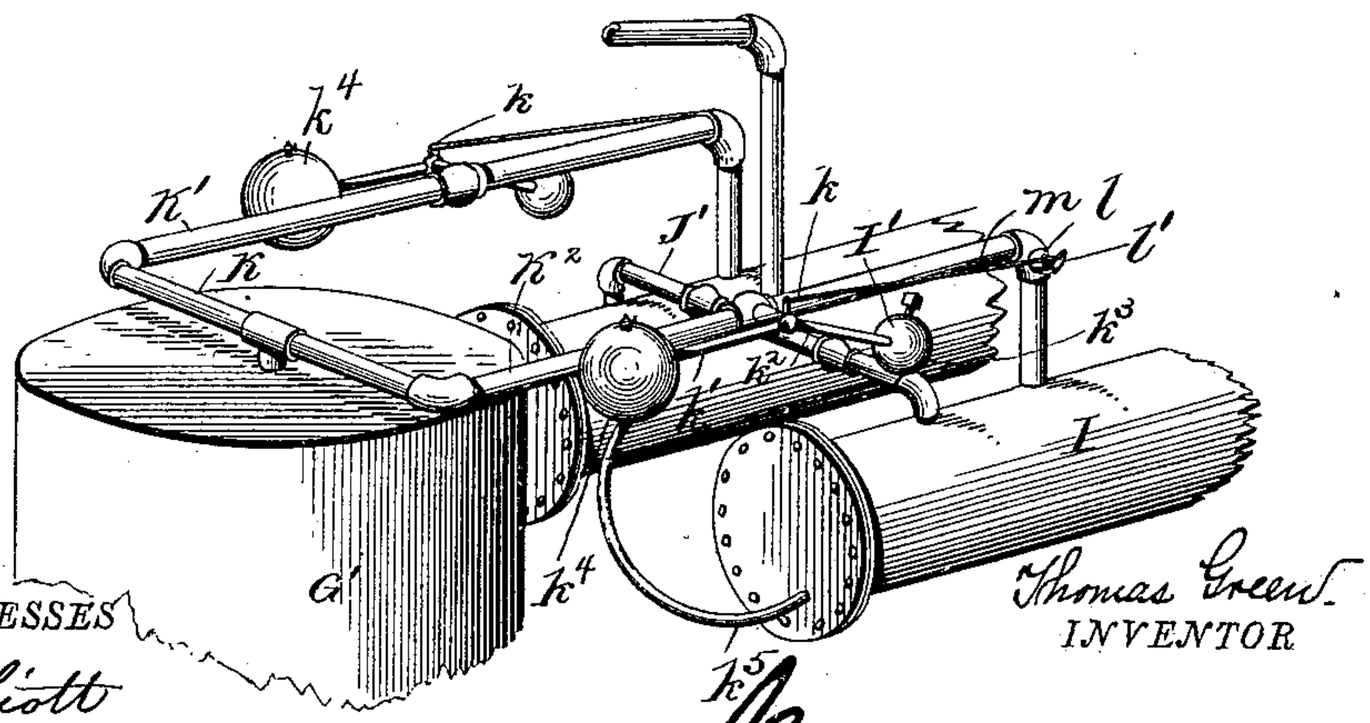


Fig. 6.



WITNESSES

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UNITED STATES PATENT OFFICE.

THOMAS GREEN, OF JOPLIN, MISSOURI.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 344,268, dated June 22, 1886.

Application filed March 19, 1886. Serial No. 195,853. (No model.)

To all whom it may concern:

Be it known that I, THOMAS GREEN, a citizen of the United States of America, residing at Joplin, in the county of Jasper and State of Missouri, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as 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 letters or figures of reference marked thereon, which form a part of this specification.

My invention has reference to steam-generators; and it consists in the improvements hereinafter described and set forth, whereby I am enabled to provide a generator of improved form and construction, that will operate with comparatively small amount of water, and at the same time effect a considerable saving of fuel and heat and render the circulation of the water automatic.

In the accompanying drawings, forming part of this specification, Figure 1 is a perspective view of a steam-generator constructed in accordance with my invention. Fig. 2 is a side elevation, the furnace proper being sectioned. Fig. 3 is a transverse section of the furnace and its grate. Fig. 4 is a transverse vertical section taken through the boiler, feed-drums, and water-circulating tubes and flues. Fig. 5 is a sectional view illustrating the interior arrangement of the condenser; and Fig. 6, a detail perspective view illustrating the device for automatically supplying and emptying the feed-drums.

In order to systematically describe my improvement I shall first confine the description to the furnace proper, and then detail the arrangement of the remaining parts of the generator.

A refers to the body of the furnace, which may be of any preferred form or shape, and contains at its top, rear, and upper portions of its sides an interior wall, B, between which is formed a water-space, B′.

a designates a bearing located on the inside of the furnace at its rear walls.

a′ designates a second bearing formed in the front wall of said furnace, and within these bearings *a a′* bears a horizontal shaft, C, which extends longitudinally through the upper portion of said furnace, as shown most clearly in Fig. 2, the said shaft projecting beyond the front of the furnace and carrying a series of graduated pulleys, *b*. The said shaft is hollow and connects with a tube, C′, which is arranged, as shown in Fig. 2, concentric with said shaft to form a revolving grate. The rear end of the tube C′ communicates with the water-space B′ through the shaft C and stuffing-box.

A hopper, D, is located above the furnace, and communicates with the latter through an inclined feed-duct, *d*, which is adapted to deliver the fuel into the front of the revolving grate at a point above the front bearing, *a′*, the hopper D being provided at its bottom with a transverse feed and reducing roller, *d′*, which latter is driven by any suitable source. The shaft of the roller *d′* is belted with one of the pulleys *b*, so as to drive the shaft C. A fan or blower, D′, has its air-duct d^2 arranged to deliver a blast of air through the revolving grate in a downward direction toward the rear thereof.

It will be noted from Fig. 2 that the shaft C is so mounted in its bearings *a a′* that it inclines slightly toward the rear, causing a like inclination in the position of the revolving grate. By this means any improper accumulation of fuel at the front of the grate is prevented, while an even regular feed of said fuel toward the rear of the grate is insured. Inasmuch as the shaft C and its grate are located in the upper portion of the furnace, a sufficient space remains in the lower part of the same to be utilized as an ash-pit, to which access may be readily had through an opening covered by a door, d^3, located at the front of the furnace.

E E refer to horizontal pipes, which are connected together at their ends by horizontal and vertical bends E′ E″, and within these pipes are located pipes F F, which communicate at one end with the lower rear portion of the furnace and at the other end with a smoke-stack, E^3, so that the said pipes F F and their bends constitute a continuous flue to convey the products of combustion from the furnace. It will thus be seen that an annular water-space is

formed between the pipes E and F, which water-space is connected with the water-space of the pipes E E above and at one side by means of pipes *f*.

e e designate small tubes, which are arranged horizontally in the upper portion of the pipes F, and are connected together by return-bends, so that the tubes *e* in each pipe F constitute a continuous water-tube, which is connected at each end with the annular water-space surrounding. The water-space of the lower pipe E, which is first in the circulation, is supplied with water from the furnace by means of a pipe, *f'*.

Centrally over the upper pipes E E is located a horizontal boiler, G, which communicates with the water-spaces of the upper pipes by means of inclined pipes *g g*, which also serve as a supplemental means for supporting said boiler. The boiler G is provided with a steam-dome, G', which may communicate with the steam-chest of an engine to operate the latter. It is intended that exhaust-steam from said engine will be returned by a pipe, *g''*, to a condenser, H. The construction of this condenser is most clearly shown in Fig. 5, and consists of a case, *h*, in which are located a series of vertical tubes, *h'*, communicating with the atmosphere through openings in the top and bottom of the case. By this arrangement the steam admitted to the condenser is condensed by coming in contact with the tubes. In the top of the condenser is located an opening, which is guarded by an exteriorly-threaded nipple, *h''*, designed to form a seat for a valve, *h'''*, which is limited by a cage, h^4, composed of a series of curved wires carried by a nut, h^5, which engages said nipple and limits the removal of the valve. The end of the pipe *g''* which enters the condenser extends up a short distance into the same, so that its end will constitute a seat for another ball-valve, *g'''*, which is limited by a cage carried by said pipe. It will be understood that the valve g^3 prevents any back pressure that might be exerted from the condenser through the pipe *g''*.

g' is a pipe which communicates with the condenser through the top thereof, and is adapted to supply water to the condenser from any suitable source, in order to supply any deficiency in the amount regularly required. In the case *h* is located a glass panel, *i*, which permits a thermometer on the inside of the condenser to be readily inspected from the outside, in order that the attendant may be informed to what extent and at what temperature the steam is being condensed. A water-gage, *i'*, on the case *h* indicates the amount of water in the condenser when desirable.

Above the boiler G are located two parallel steam-drums, I I', each of which is adapted to be supplied with hot water from the condenser by means of a pipe, J, which intersects a horizontal pipe, J', the ends of which communicate, respectively, with the drums I I'. In the pipe J' at either side of the pipe J is located a check-valve.

A horizontal pipe, K, communicates at its center with the steam-dome, G', and the ends of said pipe K are connected to horizontal pipes K' K'', which extend rearwardly and enter the drums I I' beyond the pipe J'. Each pipe K' K'' is centrally provided with a valve, which is opened and closed by the part revolution of a spindle, *k*, extending through the side of the pipe. Rigidly mounted on the end of said spindle is a bell-crank lever composed of the parts k' k^2, and supported at its middle, as shown in Fig. 6. The part k^2 is inclined and carries an adjustable weight, k^3, while the other part, k', is normally maintained horizontally by the weight k^3, and carries at its end a hollow iron ball, k^4, which is connected by flexible tube k^5 with the end of the adjacent drum. The ball k^4 is hollow and provided with a small check-valve. Each of the pipes K' K^2 is provided above the point where said pipe enters the drum with an escape-valve, which communicates with the atmosphere, and has a spindle, *l*, projecting through the pipe and carrying part *i'*, which is connected by a rod, *m*, to an ear located on the bell-crank lever composed of parts k' k'.

In operation, the water after being heated in the furnace passes therefrom through the water-space and tubes, where it is subjected to a further heating by the products of combustion in the flue, thereby utilizing the greatest possible amount of heat. Steam passes into the boiler G, and from thence is supplied to an engine, after which it returns to the condenser, as previously described. It is desirable that the water should be taken from the condenser for recirculation at the highest possible degree without going into steam, the higher the temperature the quicker heated and the greater the saving in fuel. This desideratum is accomplished by using the thermometer and glass panel, so that the attendant will always know at what temperature the water is being drawn from the condenser. In order to insure the proper automatic return of the condensed water to the circulating-tubes and jacket of the grate and furnace, the following occurs: Hot water is admitted from the condenser to one of the drums, (say drum I,) and when said drum is filled the water passes through the tube k^5 to the hollow ball k^4, increasing the weight of the latter and causing it to descend and raise the ball k^3, thereby moving the spindle *k* and opening the valve, so that steam is admitted from the dome G' to the drum I, thereby effecting the discharge of the water from said drum through a pipe, *n*, back to the front of the shaft C, to be again heated and circulated. When all the water has passed from the drum I and ball k^4, the weight of the ball k^3 restores the lever to its first position, cutting off the steam-supply through the pipe k^2, and operating the spindle *l* of the exhaust-valve, so that the steam in the drum I will pass to the atmosphere. The water likewise passes to the drum I', and is discharged therefrom, as

previously described with regard to the drum I. The filling and emptying of the drums takes place alternately, steam entering and escaping from one drum while water enters and is discharged from the other. In order to prevent the steam in one drum from exerting a back-pressure on the water in the pipe J, the check-valves in the pipe J′ at each side of the pipe J are forced to their seat by the steam.

From the foregoing it will be apparent that the steam-generating apparatus herein described is of simple, positive, and effective operation, that the water at its most serviceable and desirable temperature is automatically returned to the furnace for reheating and circulation, and that great economy in fuel is secured.

An air-opening is made in each ball k^1, so that when water enters the air may be readily expelled.

Check-valves are located in each pipe n, adjacent to the drums I I′, so that the back-pressure of the water in said pipes n and furnace water-space cannot affect the water or steam in the said drums.

An opening is formed in the furnace-bottom, which opening is closed by a plug, in order that sediment may be removed from the water-space.

It will be observed that the rear of the grate is formed by bending the pipe composing the same spirally, until the proper diameter is obtained, after which the rings concentric with the shaft are bent horizontally.

I claim—

1. The combination, in a steam-generating apparatus, of a steam-generator, a condenser, and stationary feeding-drum communicating with said condenser, a connection between the steam-generator and said feeding-drum, and devices for admitting steam to said drum to effect the return of the water to the steam-generator, substantially as set forth.

2. The combination, in a steam-generating apparatus, of a steam-generator, a condenser, stationary feed-drums I I′, communicating therewith and with the steam-generator, and devices for automatically admitting steam alternately to said feed-drums to force the water under pressure therefrom, substantially as described.

3. The combination, in an automatic feeding device for steam-generating apparatus, of a drum, a steam-pipe communicating therewith and provided with a valve, a weighted lever controlling said valve, and a hollow ball mounted on said lever, and a flexible tube connecting said ball with the feed-drum, substantially as set forth.

4. The combination, in a feeding device for steam-generating apparatus, of a drum, a steam-water supply communicating therewith, a valve controlling said steam-supply, a weighted lever controlling said valve, a valve for said drum connected to said lever, a hollow ball mounted on said lever and communicating with the drum through a flexible tube, substantially as set forth.

5. The combination, in a boiler or steam-generating furnace, of a furnace proper, a hollow shaft mounted longitudinally therein and connected to a water-supply, a tube coiled concentrically around said shaft to form a cylindrical grate and communicating with the water-supply through said shaft, substantially as set forth.

6. The combination, in a steam-generating apparatus, of a furnace provided with a water-space, a hollow shaft mounted in said furnace and provided with a revolving tubular grate communicating with said shaft and water-space, a discharge-opening located beneath said grate for the products of combustion, and a blower, substantially as described.

7. The combination, in a steam-generating apparatus, of a furnace proper having a water-space and a discharge-opening for the products of combustion, pipes F F, to receive said products of combustion, pipes E E, surrounding said pipes F F to form annular water-spaces, and communicating with the water-space of the furnace, steam-boiler, and condenser, and devices for returning the condensed water to the water-space of the furnace, substantially as set forth.

8. The combination, in a steam-generating apparatus, of a furnace proper having a water-space and a discharge-opening for the products of combustion, pipes F F, to receive said products of combustion, pipes E E, surrounding said pipes F F, to form annular water-spaces, and communicating with the water-spaces of the furnace, tubes e e, located within the pipes F F and connected in circulation with the water-space of said pipes and of the furnace, a boiler, and feed-water devices, substantially as described.

9. The combination, in a steam generating apparatus, of a steam-generator, a condenser communicating therewith, a pipe, g', for feeding the condenser, a stationary feed-drum communicating with said condenser, and devices for admitting steam to said drum to effect the return of the water to the steam-generator, substantially as set forth.

10. The combination, in a steam-generating apparatus, of a steam-generator, a condenser communicating therewith, a pipe, g'', for delivering steam to the condenser, and provided with a valve, g^3, to prevent back-pressure, a stationary feed-drum communicating with said condenser, and devices for admitting steam to said drum to effect the return of the water to the steam-generator, substantially as set forth.

11. The combination, in a steam-generating apparatus, of a steam-generator, a condenser communicating therewith and consisting of a case having a series of cooling-tubes passing through the same, a valved pipe for admitting steam to said condenser, a stationary feed-drum communicating with said condenser, and devices for admitting steam to said drum to

effect the return of the water to the steam-generator, substantially as described.

12. The combination, in a boiler or steam-generating furnace, of an inclined hollow shaft bearing in said furnace, a pipe coiled concentrically around the same to form circular grate and communicating with said hollow shaft, and a hopper adapted to deliver fuel to the front portion of said grate, substantially as set forth.

13. The combination, in a boiler or steam-generating furnace, of a shaft bearing therein, a pipe coiled concentrically around the same, so as to form a circular grate, the distance between the coils of one portion of the grate being greater than those at another, substantially as set forth.

14. The combination, in a boiler or steam-generating furnace, of a hollow shaft bearing therein, a pipe coiled concentrically around said shaft to form a circular grate and communicating with said pipe, and a series of graduated pulleys mounted on said shaft, substantially as set forth.

15. The combination, in a boiler or steam-generating furnace having a water-space, of a hollow shaft located in said furnace and communicating at one end through a stuffing-box with said water-space, a pipe coiled concentrically around said shaft to form a circular grate, and a shield, *p*, guarding said stuffing-box and pipe-connection, substantially as set forth.

16. The combination, in a boiler or steam-generating furnace, of a hollow shaft located therein, a tube coiled concentrically around said shaft to form a circular grate and communicating therewith, the tube of said grate being formed into concentric coils at its rear to present a back for the grate, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS GREEN.

Witnesses:
E. W. JOHNSON,
HORACE L. BEALL.